FEBRUARY 1951

THE SCIENCE TEACHER

- Physical Science Today—A Symposium
- Conservation in Elementary Schools
- A Regional Science Fair
- What—Collect in Winter Too?
- School Science Facilities Questionnaire

JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION

How PYREX Brand
LABORATORY WARE
Helps Cut
Replacement Costs
Tough, durable PYREX brand laboratory ware has the added resistance to thermal and physical shock that stands up under student knock-about use. And the extra long, dependable service that PYREX brand gives can mean substantial savings to you, especially in these days of rising costs. Accurate records kept by an Eastern College, for example, show that *PYREX brand test tubes outlasted any other type 3½ times to 1.*
Behind the outstanding advantages of PYREX brand laboratory ware is a scientific blending of physical and chemical characteristics . . . so carefully carried out that all the properties essential for economy, accuracy and durability are combined and maintained at their maximum value. See your laboratory dealer now about your future PYREX requirements.
PYREX
CORNING GLASS WORKS Corning, N.Y.
Corning means research in Glass
1851 • 100 YEARS OF MAKING GLASS BETTER AND MORE USEFUL • 1951

THE SCIENCE TEACHER

Volume XVIII

February Through December

1951

Published By

THE NATIONAL SCIENCE TEACHERS ASSOCIATION

National Education Association

1201 Sixteenth Street, N.W., Washington 6, D.C.

THIS MONTH'S COVER. Is pretty but has nothing to do with science teaching. Or does it? How about force, motion, acceleration? And the biology of exercise, health, and recreation? There is opportunity to study the states of matter, snow and ice forms, and even the beginnings of glaciology. What forms of life lie dormant, more or less, beneath the snow? Or shall we just go skiing and have fun? As for us, we'll take ours out in fishing next summer—in the same National Park.
Photo: Courtesy of National Parks Association.

Guided Missives

Editor, *The Science Teacher:*

Concerning the article on page 130 of the October *Science Teacher* by Guy V. Bruce . . . since a deflated ball will displace less air than an inflated ball, the buoyance effect of the air on the deflated ball will be less than on the inflated ball, and the effect will be to compensate, thus the two balls will weigh the same.

A difference in weight will occur, though, if the ball is inflated under pressure. If the ball is inflated to about 30 pounds pressure, then the effect will be as shown in the drawing of the article.

A better way to demonstrate the weight of air is to boil water in a bottle and then to stopper the bottle while the water is still boiling. By weighing the stoppered bottle, the weight of the bottle without air can be determined. When the stopper is taken out of the bottle, the air will rush in and the bottle will weigh more which can be determined.

Gordon H. Williams
Fort Bragg Schools
Fort Bragg, California

Editor, *The Science Teacher:*

I feel that you did an injustice to Mr. Standen's book, *Science Is a Sacred Cow* (October, p. 137). It is not my primary intent to dispute Dr. Morrison's right to write this review for *Science* or any other technical journal of the sciences. It *is* my intent to question the selection of his review for use in *The Science Teacher* or any other journal which deals with people instead of things.

As educators we should have some of the philosopher in us and should be able to look at science from without and see it for "what it is—and is not" (to borrow six words from F. G. Watson, p. 113 and p. 146 in the same October issue of *The Science Teacher*). We are awed (and rightfully so) by the scientific method as being the best manner we have of discovering facts about things. The rub comes when a few people believe that the method can be applied to anything and everything in our existence. A book which brings out the limitations of science should have a sobering influence in some quarters. A book which battles against science as the godhead of today should have a broadening influence on the minds of men.

For those who read the book in spite of the review presented, my congratulations! For those who did not, my sympathy, for they have missed an intellectual adventure. It is my contention that this is a book to be *read* (especially by science teachers), and that the review you selected was not conducive to that end.

David F. Taylor
Student, Graduate Division
School of Education
Syracuse University

THE SCIENCE TEACHER

Journal of the
National Science Teachers Association

RALPH W. LEFLER, President
NATHAN A. NEAL, Retiring President
ARTHUR O. BAKER, President-Elect
WALTER S. LAPP, General Vice President
HANOR A. WEBB, Secretary
ELBERT C. WEAVER, Treasurer
ROBERT H. CARLETON, Executive Secretary

THE SCIENCE TEACHER goes to all members of the Association. Membership dues, including publications and services, $3 regular; $6 sustaining (of each, $1.50 is for Journal subscription). Single copies, 50¢. Published in February, March, April, October, November, and December. Publication Office, Business Press, Inc., 10 McGovern Avenue, Lancaster, Pa. Editorial and Executive Office, 1201 Sixteenth Street, N. W., Washington 6, D. C.

Entered as second-class matter at the Post Office at Lancaster, Pa., under the Act of March 3, 1879. Acceptance for mailing at Special rate of postage provided for in the Act of February 28, 1925, embodied in paragraph (d) Section 34.40 P.L.&R. of 1948.

Editor, *The Science Teacher:*

Enclosed are two coupons from the "Clip 'n Mail" section of *The Science Teacher*—October issue. This is a very convenient service that enables me to make eighth-grade science more interesting to 220 students.

I would like to express my thanks for sections such as "Demonstration Ideas From Overseas" and "Which Test Tubes Shall We Buy?" Both are extremely helpful and should, if continued, result in new members in the NSTA because of meeting a long-neglected need and service to science teachers.

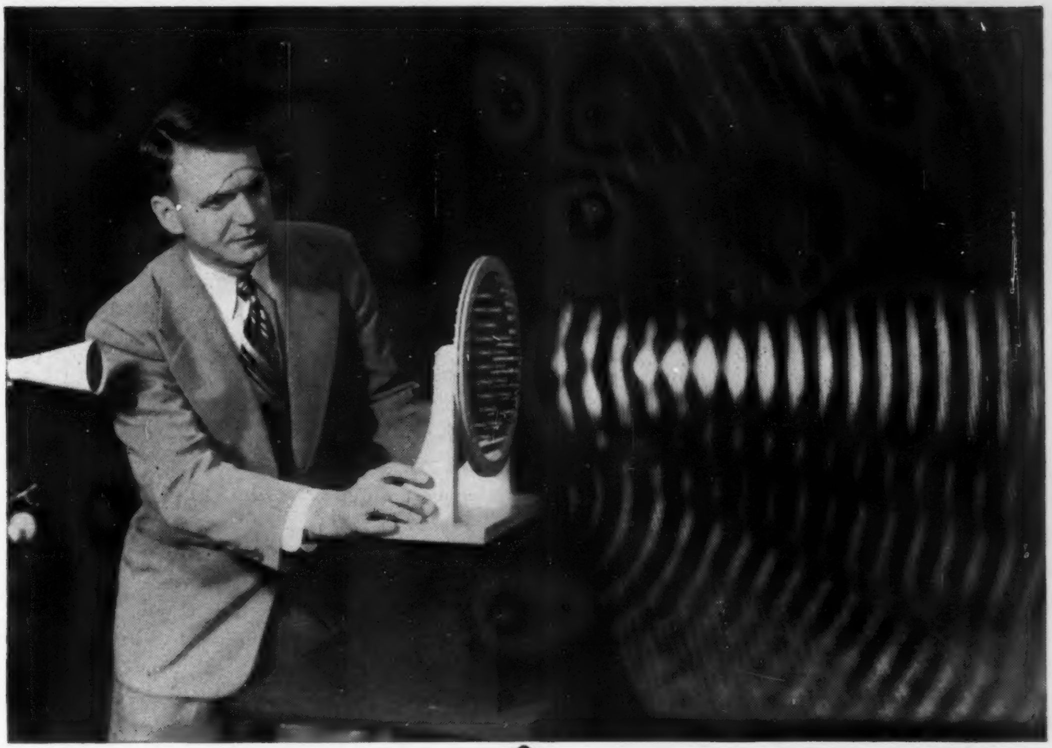
ROBERT F. HARPER
Roosevelt Junior High School
Columbus, Ohio

Executive Secretary
National Science Teachers Association

At this time I would like to tell you how much I enjoy *The Science Teacher* and look forward to each issue. As I am a beginning teacher, I naturally look for simple demonstrations found to be useful in aiding students to learn. Is it possible to have more of them in future issues?

CYRUS LARMOYEUX
Kinder High School
Kinder, Louisiana

EDITOR'S NOTE: We hope so. See Editorial, page 11.



Editorial Consultants, THE SCIENCE TEACHER

(Current group of consultants "on tap" to aid in reviewing and editing manuscripts falling within their particular fields of professional interest.)

Officers and Executive Committee 1950–51

(For list of NSTA Regional Vice-Presidents and Directors, for 1950–1951, see page 43.)

THE SCIENCE TEACHER

Vol. XVIII, No. 1 **February, 1951**

The National Science Teachers Association is a Department of the National Education Association and an Affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction, the Association later became the American Council of Science Teachers. It merged with the American Science Teachers Association and reorganized in 1944 to form the present Association, and **The Science Teacher** became the Official Journal of the new National Science Teachers Association.

Editorial

Foundation of the Foundation

A National Science Foundation is now public policy in the United States. The first National Science Board has been appointed. Pre-college science education, as such, is *not* represented among the Board's membership. This, we think, is regrettable. On the other hand, several members of the Board are well informed on the problems and present status of science teaching in our secondary and elementary schools. And this, we think, is good.

If the purposes of the NSF are to be realized fully in the years ahead, we must not lose sight of the fact that the scientists of tomorrow are in the nation's elementary and secondary schools of today. Moreover, in our schools today are the *citizens* of tomorrow—the men and women whose attitudes and beliefs will largely determine the conditions under which scientists will work, and whose votes may decide whether a National Science Foundation is to be continued.

We cannot afford to de-emphasize or neglect science instruction at the earlier educational levels today and simply *hope* that we'll have a scientifically literate citizenry and a revealed wealth of science talent ten years or more hence.

Confident that the Board is cognizant of the situation, it is our hope that effective lines of communication will promptly be established between the NSF and all pre-college science education. Further, it is our suggestion that possibly the most appropriate liaison group is the AAAS Cooperative Committee on the Teaching of Science and Mathematics. In any such cooperative endeavor NSTA may be counted upon for enthusiasm and full support.

It's *Your* Journal

Perhaps it is not sufficiently clear that acquisition of *The Science Teacher* by NSTA was made possible by (a) the cooperative attitude of former owner and editor, John Chiddix of Normal, Illinois, a long-time NSTA'er himself, and (b) a long-term, no-interest loan accorded us by the National Education Association.

Anyway, *The Science Teacher* is now our baby, and with this number we have lived through four issues under NSTA management and editorial policy. Naturally, we want to make it a journal that no conscientious and professionally-minded science teacher can afford to be without; also, a magazine that is a "must" for every elementary school in the nation and for every professional library. From your letters and comments on the first three issues we know you think pretty well of our initial efforts.

However, let us be the first to suggest that "the honeymoon is over." What we need now is neither orchids nor razzberries but considered criticisms, suggestions, and ideas. And most of all—manuscripts. Your editors can do something about the design and format of the journal, but fundamentally its professional content can be no better than our contributors make it.

Part of this responsibility is *yours*. What can you do about it? What *will* you do about it?

ROBERT H. CARLETON, Executive Secretary
National Science Teachers Association

PHYSICAL SCIENCE *Today*

A Symposium on Present Practices and Perplexing Problems in the Area of Modified Courses in the Physical Sciences at the Senior High School Level

OUR experiences of recent months have led to the conclusion that brief accounts of current efforts directed toward modifying the physical science portion of the curriculum, if reported through the pages of *The Science Teacher,* would be helpful to many teachers throughout the nation. Hardly a week goes by without our receiving an inquiry for "a course of study in physical science," or "the name of a teacher or school having a successful course," or "what is the trend with respect to substitute courses for conventional chemistry and physics?" Conversations with teachers during our field trips and our attendance at various conferences and meetings reveal deep interest in these questions and much concern, some on the "negative" side, with the proposed solutions. At the recent meeting of the Physics Section of the Central Association of Science and Mathematics Teachers, about 50 of the group remained more than half an hour beyond scheduled closing time to continue a discussion of physical science and the curriculum.

Actually, of course, the whole idea is neither new nor recent; "science fusion," "generalized physical science," "physics and chemistry A and B," and so on, have been in the air for at least 20 years. During this time a considerable body of related literature has accumulated, and it is our regret that space limitations preclude giving a bibliography to accompany this symposium. Meanwhile, the movement toward "general education" science has gained much momentum at the college level—perhaps more than at the high school level. However, the recent U. S. Office of Education report, ***The Teaching of Science in Public Schools*** (pp. 22–23), lists by title 11 different groups of alternate courses offered, apparently, in addition to, or in lieu of, the usual general science, biology, chemistry, and physics; further, the report indicates that about 19 per cent of the high schools offer one or more such courses. More than half of the courses reported fall into the physical science area.

And so we come to our present symposium, in which nine courses scattered all over the country are reported. The accounts and course outlines that follow have been arranged so as to approximate a continuous and developmental story. Confident that their contributions will be appreciated, we express apologies to the participants in this symposium for the editorial reductions in many of their manuscripts. Space limitations and the avoidance of duplication have been the compelling reasons.

Admittedly the nine courses in this symposium represent a selected sample, perhaps even biased; but the purpose is to report promising and successful practices—not to delve into the question on a research basis. Whether the effort has been successful, and whether we go farther with this inquiry, is for *you* to judge.

Mr. O. A. Nelson of Wilson High School, St. Paul, has developed a course emphasizing "physics in daily use." Here is what he has to say about it.

"If pupils are to receive the greatest benefit from the time spent in the classroom, the material taught must be on the ability level and interest level of the individuals. However, with 25 to 40 pupils in a class, each having different interests and varied abilities, how is it possible to teach in such a way that each pupil can profit to his full capacity? This paper will deal with one method that has proved successful, for the writer, in teaching physics.

"Our first attempt was made by dividing the pupils into groups according to their abilities and interests. This arrangement led to some improvement, but there were also some serious weaknesses. A heterogeneous grouping was used the next year, and this was found to be much more satisfactory. A

number of procedures were used to meet individual differences in such a grouping.

"We felt that in any science class each member should do individual work in the form of projects; also that, as far as possible, class time should be given for this work. In most cases this may be accomplished in much the same way as is done when we carry on the usual laboratory experiments. After the project has been completed, the pupils should be given an opportunity to discuss their findings before the class. A science-minded pupil should give a much better report than one who is lacking in science ability, even though they are on a par in general ability. Also, a science-minded pupil of high general ability should give a better report than a science-minded pupil of low general ability, but, if their work is comparable to their ability, they should receive the same grade. If no counselling service is available, each teacher must give some tests and check other sources of information to obtain enough data to place each pupil in the proper ability classification.

"After each pupil has been placed in the proper classification, the instructor must exercise good judgment in permitting the pupil to select projects or topics for experiments and reports that are near his ability range. Care must also be exercised so pupils of high ability do not select projects that are too easy for them.

"To keep and develop interest among a large number of pupils, the subject matter taught in physics cannot be the traditional, technical, college preparatory material found in the average text. The same laws and principles must be taught, but the approach must be through experiences on the age level of the average physics pupil and with materials in which he is interested. The writer found that most high school pupils were interested in learning more about the machines used in their homes and in business places. As each machine was examined and studied, one or more of the laws or principles of physics was discussed and mastered. Note specifically that the machine was studied first and not the law or principle. Not all the laws and principles used in one machine would necessarily be discussed in connection with that machine. If this should be done, the pupils might be kept at one topic too long, and interest would decrease rather than increase. By using a checklist, everything found in the conventional physics text can be discussed in an interesting and simple way during the school year.

"Pupils of exceptional ability should be given special consideration in any class. The Westinghouse Science Talent Search offers special inducement and interest as do other similar offers of scholarships. Those pupils were permitted to work in the laboratory on their special projects during class discussion when the instructor felt that the lesson for the day had already been mastered by those individuals.

"Readers of this article will ask certain questions, and the writer will try to answer three. (1) In a course of this nature, does the pupil learn as much good sound physics as in the traditional course? (2) After having taken the above-described course, how does the pupil get along when taking college physics? (3) What evidence is there that the above-mentioned approach of physics develops more interest in the course?

"Question 1: The writer has used the above approach in teaching physics for about 12 years. Seven times standardized tests have been used as the final examinations. About five per cent got scores falling in the lower decile on the standard tests. About six per cent received scores in the upper decile. About 50 per cent of the writers' pupils received scores that were in the 35th to 65th percentiles on the standardized tests.

"Question 2: Only a small number (28) of pupils taking physics at college were checked in their progress. In no case did any one receive a lower grade than that given in their high school work. None were below the 40 per cent rank in college grades.

"Question 3: The writer has taught physics for 24 years. The last year he used the "technical approach," 34 pupils out of a graduating class of 328 had elected physics. Eleven years later in the same school 411 pupils out of a graduating class of 456 had elected physics. If numbers are a criterion, the results speak for themselves."

At Arlington Heights Township High School, Arlington Heights, Illinois, Mr. Nelson Lowry, head of the science department, and his colleagues, Mr. John Schaff, and Mr. Melvin Kulicke, have a modified science program now in its third year.

"Biology is now required for all our ninth-grade students and may be followed by a physical science course in the tenth grade. This two-year program is followed by physics, chemistry, or advanced biology for those with interests or needs for advanced work.

"It takes time to reorganize and set up a new science curriculum. Our planning began in the fall

of 1946. For two years we worked on many possible changes. The science department and administration were in agreement that general science was no longer meeting the needs of our students. The grade schools were doing what the high school had been doing in the general science course. In the fall of 1948 we dropped general science and required biology as a ninth-grade subject. We no longer are repeating the work of the grade schools. We have recognized their work, and since making our changes have found the work of elementary schools greatly improved.

"Our physical science course is now in its second year. The course is planned to be of practical value to the student as well as an introduction to the specialized courses. Student interest is increasing in this course and in others. Chemistry enrollment has increased, and we expect the same trend in physics next year. The work in chemistry has been accelerated over previous years. The students having had physical science appear to have an advantage in chemistry over those not taking the course.

"We have experienced no difficulty in changing the traditional curriculum. The science department planned the program with all the basic reasons for the changes and then outlined the proposed physsical science course before presenting the program to the administration for suggestions. The school was fortunate in having a staff of well-trained science teachers interested in the students and willing to take on the additional work involved in changing the course of study.

"The state department has recognized the changes as desirable. Colleges and universities are giving a unit of entrance credit for the physical science course."

ARLINGTON HEIGHTS COURSE OUTLINE

Introduction—2 weeks
- (1) Nature of physical science
- (2) Laboratory procedures
- (3) Measurements

Solar System—3 weeks
States of Matter—2 weeks
Energy—2 weeks
Physics—15 weeks
- (1) Forces
- (2) Force and motion
- (3) Work, energy, and power
- (4) Sound
- (5) Light
- (6) Electricity

Chemistry—12 weeks
- (1) Chemical change, oxygen, hydrogen, combustion
- (2) Nature of chemical process
- (3) Solutions
- (4) Nonmetals and their compounds
- (5) Organic chemistry
- (6) Useful metals

"Forty experiments are included which may be done as (a) teacher demonstrations, (b) student demonstrations, (c) group experiments (two–six students), or (d) individual experiments."

From the "deep South" comes this contribution from Mr. S. A. Brasfield, director of the Division of Instruction, State Department of Education, Jackson, Mississippi.

"The national trend in secondary school curriculum development is definitely toward setting up programs that are practical and tend to meet the needs of all youngsters in our secondary schools and the youngsters that should be in secondary schools that are now classed as drop-outs. The national movements directed toward 'Education and Life Adjustment,' 'The 1950 Edition of the Evaluative Criteria,' and 'The Ten Imperative Needs of Secondary School Youth' are all based on the idea that all students that go through our secondary schools should have certain experiences and training regardless of what they plan to do after leaving the secondary schools. It usually boils itself down to saying that all secondary schools should set up a Common Learning Program, which embodies from 50 to 60 per cent of the 16 units usually required for high school graduation. It is our belief that in any Common Learning Program there certainly should be an opportunity for the youngster to spend at least one year studying the biological sciences and a minimum of one year on the physical sciences.

"Many of our schools in the South require these two courses as a part of the Common Learning Program in their high schools. A course in general physical science definitely has a place in the Common Learning Program on the 11th and 12th-grade level. This does not mean that every student should take a special course in general physical science. Some students probably should take physics, others should probably take chemistry, and many students may need both of these courses; but, certainly every youngster should have at least one year of a physical science.

"In Mississippi secondary schools we are recommending general physical science for both our large and small high schools. If the school is so small that only one course can be offered in the broad field of physical science, we think the general course would come nearer meeting the needs

of all youngsters on the 11th and 12th-grade level than the specific course in either physics or chemistry. In the medium size and larger high schools of the state we definitely think there is a place for a course in general physical science for those students that do not take physics or chemistry. However, we feel that a very high percentage of our students in the 11th and 12th grades in all our high schools need a general course in physical science more than they need a technical course in physics or chemistry.

"We believe the course should include laboratory work. We certainly think there is a place for visual-aids and field trips. We would definitely encourage pupil-teacher planning, not so much in the sense of what units will be studied, but how the units will be studied."

Is New England as conservative as sometimes pictured? Mr. R. E. Keirstead, head of the science department, Bulkeley, High School, Hartford, reports on his experimental physical science course.

"A survey of Bulkeley High School juniors and seniors showed that a considerable percentage of non-college preparatory pupils were being graduated without taking any science courses during the last two years of high school. In view of the importance of science in modern life it was felt that most pupils should take at least one course in science during the final two years of high school in order to have the intelligent appreciation of the methods, potentialities, and limitations of science so necessary for a citizen of today. Accordingly, a single experimental class in physical science was set up in September, 1949, with the express purpose of trying to find the answers to two questions: (1) What subject matter from the area of physical science is of real interest and significance to pupils at the 12th-grade level and who are not going to college? (2) What methods of teaching are best suited in presenting this subject matter?

"At the first meeting of the class the pupils were informed that the aim of the course was to provide them with a concept of the role science is playing in modern life and with information and points of view of immediate usefulness in understanding science as it is met in newspapers and magazines, on radio and television, and in the materials and gadgets of daily life. No textbook was adopted as it seemed likely that this might prevent the development of the course along the lines of interest of the pupils. Excellent library facilities in our school made it possible to carry on the course without serious inconvenience from lack of a text. The adoption of pupil planning as a technique proved to be a happy one but did not make the role of the instructor any less important. Rather, his task was more difficult than in a formal course for he had to show considerable ingenuity in guiding discussions and in directing the learning process toward desirable ends. Many members of the class had had very poor academic records yet, when given an opportunity for active participation, presented many intriguing and surprisingly searching queries.

"The course was organized around large topics or units. Each such unit was chosen by vote of the class after a free and often exhaustive discussion. A study guide consisting of questions to be answered was then prepared in mimeographed form by the instructor. Demonstrations, motion pictures, and other visual aids were used as widely as possible. No individual laboratory work was done. The treatment of scientific principles was almost entirely qualitative. Very little written homework was assigned. Quizzes were held frequently with full period examinations at the end of each marking period.

"The major units of the course were: (1) Providing a Supply of Water, (2) Atomic Energy, (3) Mineral Resources of the World, (4) Metals of Importance to Modern Life, (5) Building Materials, (6) Fuels, (7) Synthetic Substances, (8) The Automobile, (9) Communication, especially Radio and Television, (10) Photography, (11) Weather and Its Forecasting, and (12) Astronomy.

"One might suspect that the method used in organizing the course would result in a hodge-podge of isolated and unrelated topics, lacking the unity and coherence of a formally-planned course. This did not prove to be the case. The great concepts of science so permeate its whole body that they furnish an excellent framework about which any subject matter can be grouped. The atomic theory, the kinetic molecular theory, the electron theory, the principle of conservation of matter and energy, the concept of radiant energy, and other similar ideas provided a satisfactory unity.

"The guidance staff of the school evaluated the course through personal interviews with pupils. It was the unanimous conclusion of the guidance counsellors that the pupils had profited greatly from their experience in the course. Pupils' anonymous statements concerning their reactions to the course proved valuable not only in showing the course to be of value but also in providing suggestions for improvement.

"From our experience to date it seems clear that many high school pupils who heretofore have avoided the traditional high school science can profit markedly from a generalized physical science course built around aspects of science which are of real significance to them in their daily living. Furthermore, it seems entirely possible to develop a real appreciation of the part that science plays in the world of today, even in the less able pupils. We believe that more regular and careful daily preparation would result from the use of a textbook. However, if the advantages gained from pupil participation in planning the course are to be retained, the textbook must be used as a source book rather than an outline to be followed rigorously. Possibly the organization of texts on physical science should be along different lines from those now available."

The Baltimore County, Maryland, public schools offer two years of consumer science for senior high school pupils who do not need or want conventional courses in chemistry, physics, and in some cases, biology. Miss Helen Hale, supervisor of secondary schools, reports on this program.

"The genesis of our present consumer science program may be traced to the late 1930's when several Baltimore County teachers began to experiment with a modified course in senior high school science. The experiences of these teachers and their classes produced a tentative course of study in senior science which was used for seven years. When later curriculum committees sought to establish a set of specific purposes for a somewhat broader program of consumer science, they did so on the basis of the findings of the senior science teachers, as well as on such other factors as (1) the meager results of research in the area of modified science, (2) the principles for secondary education set up at a 1945 state workshop and set forth in a series of bulletins called *Maryland Looks Ahead in Education,* and (3) the philosophy and major purposes for senior high school science which had been developed in a 1948 county workshop.

"Committees of teachers working during the year and in summer workshops have prepared tentative courses of study which include six units for each year of consumer science. The units themselves are somewhat of a resource nature so that each group of pupils may develop their study along lines best suited to their interests and needs and in the light of their past educational experiences. For example, the unit dealing with the human body, which was placed in the course as essential for pupils who have not had biology, is frequently omitted for at least part of the class, inasmuch as many pupils do not decide to elect consumer science until after they have already had a course in biology.

"Because there are no stringent subject-matter requirements, emphasis can be placed on rich and functional learning experiences rather than on ground-to-be-covered. Pupils are given many opportunities to learn directly, even though this type of learning is time-consuming. For example, one consumer science II class recently decided to spend a rather large block of time on the unit, *Building and Equipping the Home.* In their study the pupils viewed six sound films and seven filmstrips, studied 26 different government and commercial pamphlets, used several dozen reference books and read numerous magazine and newspaper articles, took six class-wide field trips and made four group visits, built seven large models, made eight collections, prepared some 20 posters, performed eight experiments (several of a controlled nature), engaged in many informal discussions and two panel discussions, arranged six bulletin boards and three exhibit-case displays, prepared a photographic summary of their activities, made a set of slides to summarize the unit learnings, and wrote and recorded a script to accompany the slides. In this class, as in most consumer science work, much of the learning was done by groups formed on the basis of common interests.

"The laboratory work in consumer science is largely pupil demonstration, and no special laboratory period is included in the schedule. The classes meet for five 50-minute periods. However, school administrators have been cooperative in arranging temporary schedule adjustments which permit community study and other types of field work.

"A variety of reference books is supplied for classes in consumer science with material available on several reading levels. No textbook now on the market seems to be especially well-suited to our consumer science program.

"No study has been made of the success of consumer science or of the effect of this program on the achievement of pupils in the traditional senior high school science courses. Informal analysis shows, as one might expect, that consumer science is successful in some schools and not in others. In most instances the teacher seems to be the factor which determines the popularity of the course in terms of enrollment and the enthusiasm and satisfaction of the pupils once they are enrolled. The

flexibility and possibilities within consumer science motivate some teachers to exceptional effort and subsequent success; the same conditions merely overwhelm other teachers.

"The major unsolved problem in consumer science is the in-service training of teachers in order that they may accept and implement the philosophy and objectives of the course. Other difficulties concern scheduling to permit more flexibility, the need for a greater variety of teaching materials, and the task of selling the program to parents."

CONSUMER SCIENCE I

(1) Chemistry for Our Daily Needs
(2) Nuclear Energy: Its Use and Control
(3) Using Water Wisely
(4) The Human Body
(5) Man and the Universe
(6) Resources and Industries of Baltimore County

CONSUMER SCIENCE II

(1) Machines in Modern Life
(2) Electricity at Work Today
(3) Building and Equipping the Home
(4) Modern Medical Science
(5) Biological and Mineral Resources
(6) Research and Testing Laboratories

Now let us see how the general physical science course is handled in the Ann Arbor High School, Mahlon H. Buell, head of the science department, reporting.

"General physical science for college preparatory students is so new in the Ann Arbor High School that the content and methods used are very definitely in the experimental stages. Its purpose is to provide an integrated course embracing some of the fundamental principles of chemistry, geology, astronomy, meteorology, and physics. It is elective for juniors and seniors who wish a laboratory physical science course. Entrance officials of the University of Michigan have agreed to accept it as a substitute for one unit of physics or chemistry when offered for entrance credit.

"College-bound juniors and seniors definitely feel a need for an understanding of their physical world and environment. They want to know the facts about the universe, from the remote and gigantic galaxies to the tiny atomic nucleii. They are hungry for knowledge and are anxious to fit all new information into a philosophy of life that they can accept for themselves. This makes it possible to organize a physical science course around such broad physical principles as the law of gravitation, the conservation of matter and energy, and the molecular and atomic structure of matter.

"The problem of finding a suitable textbook has not yet been solved. Several of the books in this field are intended for non-college preparatory groups; others definitely segregate the sciences into sections on physics, chemistry, astronomy, or geology. The latter are difficult to use in a course in which one of the aims is to integrate the subject matter into a unified whole. The textbook used in Ann Arbor, *The Study of the Physical World* by Chernois, Parsons, and Ronneberg (Houghton Mifflin Co.), certainly overcomes these objections but is too difficult for high school students; in fact, it is a college textbook. It is hoped that some of the forthcoming new books and revisions of present texts will be written for college preparatory students.

"The class meets for a double laboratory period twice a week. Among the more unusual experiments, exercises, and trips attempted are the following: a globe study including latitude, longitude, and time; the use of a slide rule; a study of weather maps; making photographic contact prints and enlargements; assembling a one- or two-tube radio set; the study of geysers, falls, mountains, canyons, rocks, and shore lines by means of colored slides; observations of the moon and planets through a telescope; trips to the Willow Run weather station and to the University of Michigan astronomical observatory.

"As the basis for the selection of subject matter frequent reference is made to other textbooks and course outlines. Greatest reliance is placed on *Principles and Experiments for Courses of Integrated Physical Science* by Vaden Miles, Wayne University, Detroit. In this book principles and experiments are rated in descending order of importance and experiments for both demonstration and individual student work are listed for each principle.

"The outline of course units is by no means fixed and final, but in general takes the following form."

Introduction—Physical Science and Its Place in Our Lives.

(1) The earth as a whole and its closest neighbors
(2) A more detailed study of the earth
(3) Some results and effects of gravitational forces
(4) Motion, a special effect of force
(5) Energy, the agent of change
(6) The molecular nature of matter
(7) The nature of chemical change
(8) Minerals, ores, and other natural resources
(9) Electrical energy, man's great servant
(10) Light energy, carrier of information
(11) Atomic energy and radiation, both dangerous and beneficial

Next we hear from Dr. John Hogg, who describes the course he has developed at Phillips Exeter Academy, Exeter, New Hampshire.

"What is a profitable alternative to the usual courses of chemistry and physics in grades 11 and 12? In seeking an answer to this question we must first raise the perennial query, 'Why teach science at all?' If we accept the dictum that the primary goal of science teaching is to understand nature, we must set our sights so as cover a wide range. The course must be broad in its scope; it must cross the conventional barriers that are usually erected between the branches of physical science; it should correlate the branches and stress their interdependence.

How can the parts be correlated and integrated? One method is to select a unifying theme and weave the story about it. A central theme that has proved satisfactory is the topic of *combustion.* It cuts readily across the boundaries. From chemistry it meanders through heat, electricity, and into light and electronics. It wanders just as easily into metallurgy, geology, meteorology, and even into astronomy and nuclear energy.

"A course built around the combustion theme could begin with oxidation, fire, and fuels, including oil and coal. The origin of coal and oil lead naturally into some aspects of geology, and it is only a slight diversion to take up such topics as the rocks of the earth, the changing earth, the record of rocks.

"Returning to the theme, temperature and heat effects should next be considered. This should include evaporation, condensation, and the methods of heat transference. This background offers an easy approach to meteorology, and such topics as winds and air masses, fronts and storms can be studied intelligently.

"Returning again to the central theme, the decks are now clear for a discussion of the steam engine, the internal combustion engine, and the airplane. Combustion in the production of electricity is next in line, and a study of the generator and transformer leads quite naturally to electric lighting. It is now an easy hurdle to jump to reflection and refraction of light. A study of telescopes takes us into astronomy, and this in turn leads to 'combustion' in the stars and to nuclear energy.

"Once the central theme of *combustion* has been selected, there are obviously many different routes across the boundaries, depending on the whims of the teacher and the interests of the students. The outline given at the end of this article shows the route the writer has followed for a number of years.

"In our course classes meet four times a week throughout the year, each period being 50 minutes. There is no required laboratory work, but field trips are a rigid requirement For example, we visit the local water works and see water purification on a large scale. Our geological expedition is to a rocky section of a nearby beach. Another worth-while trip is to see high-pressure steam operating turbines and the turbines operating generators; and still another is the manufacture of water gas. The management of industrial plants generously cooperate and even provide guides to explain the operations. Students take notes, and these are then expanded into an illustrated theme which must be handed in to the instructor not later than one week after the trip.

"This writer is convinced that every student should be *required* to work on a project dealing with some aspect of the course that may interest him. There is no doubt that a project is a potent educational tool. At its worst, it ensures that a student does manual work in applied science; at its best, it provides an intellectual stimulant. Usually the student shows considerable interest in his project and sometimes considerable ingenuity. The best projects should be suitably labelled and put on display. A good display introduces a little healthy competition and is an incentive to skilled workmanship."

Physical Science at Exeter

(1) The Nature of Common Things
(2) Earth Science
(3) Some Effects of Heat
(4) Weather
(5) The Chemistry of Fire
(6) Power from Combustion
(7) Combustion in the Production of Electricity
(8) Light
(9) Communications
(10) Some Chemical Industries
(11) The Universe

Down to Texas next for an account of the general physical science course developed by Frank C. Guffin, head of the science department in Austin High School.

"Our course is designed primarily for non-college students. However, it does carry college entrance credit as a laboratory science with the University of Texas. Periods are an hour long, and we allow at least one laboratory period per week throughout the year.

"About 1000 students per year 'track' through our high school physical science course. We at-

tempt to evaluate the success of our plan through conferences with students, teachers, and guidance counselors. We *believe* we are making good headway toward achievement of our goals.

"One of the handicaps, we feel, is the one-hour period which, in a large school, severely limits our use of field trips, projects, community resources, and the like. Transportation for such purposes is another problem. Finally, we have a problem to keep this course from becoming a 'snap' course for students readily susceptible to avoiding work.

"We have not found any of the published textbooks completely satisfactory for our purposes. We rely heavily on one text, but two additional ones, plus other supplementary materials, are always available to students. The problem of guides for laboratory work is more troublesome than that of a text. We have had to write our own.

"The unit areas included in our course usually include most of the following."

(1) Understanding Science
(2) Water
(3) Fire and Fuels
(4) Simple Machines
(5) The Atmosphere
(6) Foods and Drugs
(7) Sound
(8) Light
(9) Building Materials
(10) Home Appliances

And now a hop all the way across the continent for a look at the modified physical science offering in the Los Angeles public schools. Reporting is Miss Archie J. MacLean, supervisor, science education section, curriculum division.

"We no longer have enrolled in our high schools only those students who are preparing for college, but we have enrolled today most of the youth of high school age. Consequently, our offering and methods of teaching must be adapted to this changing situation. High school science courses must not only prepare students for technical work in college but must prepare all students to live in a world of science.

"The most difficult problem is to determine what science instruction should be given to the nontechnical student in order to prepare him to live in a world of increasing technical development. The following criteria were used in setting up content for the course as presented here. Areas for study should contribute to: (1) An understanding of the basic laws of nature; (2) The solving of problems that arise in daily living such as buying goods, providing for greater convenience and comfort in the home; (3) Developing skills in critical thinking so that students will act as a result of thinking through a problem and not as a result of prejudice or tradition; and (4) A realization of the impact of science upon social life.

"The areas of study that follow are suitable and practical for use in a physical science course at the 11th or 12th-grade level for non-academic students."

Area I.	How does climate affect our way of living?
Area II.	How can we secure an adequate water supply?
Area III.	What should we know about buying clothes and household supplies?
Area IV.	What should we know about the construction of our homes?
Area V.	How can we become better users of machines in our home?
Area VI.	What means of communication have been developed for our use?
Area VII.	How can we make the best use of our transportation facilities?
Area VIII.	What do we need to know about our earth and universe?

"Suitable textbooks for physical science are limited. Much of the reading material for the course must come from supplementary materials. The teacher who has a well-stocked cupboard of printed materials from industrial firms, government publications, and current magazines is fortunate. As we all know, a wealth of useful material has been distributed through the Packet Service of the National Science Teachers Association.

"Classes in physical science should be carried on in a laboratory shop. There should be facilities for examining motors, testing household appliances, learning how to make simple household repairs, building a miniature wind tunnel, setting up and maintaining a weather bureau, and trying out various experiments to answer problems that have been raised in the discussion period. The use of equipment that is familiar to the student and that he sees frequently in stores and at home will help to make the course have direct application to everyday use. There should be a great deal of storage space for materials that teachers and students have collected, such as an old vacuum cleaner, automobile motor, student projects, etc.

"Providing the type of science course that this modern world seems to demand is not an easy task. Some teacher training institutions seem to be unaware of the need for broader basic science training for science teachers. Science teachers are usually well equipped for teaching the traditional courses, but to be a good physical science teacher

requires a broad science background with emphasis on practical applications. Such a program for pre-service education is rarely found. Opportunity for student teachers to carry on practice teaching in physical science is unusual, yet it should be a part of the training of science teachers preparing in the field of the physical science.

"The breaking away from the traditional pattern of physics and chemistry for the 11th and 12th grades is a difficult problem in some school situations. The attitude on the part of some science teachers that teaching physical science is beneath their talents is a problem to administrators. If such teachers would try to develop a physical science course to its fullest possibilities, they would soon find their ingenuity challenged to its greatest extent—far greater, even, than in 'traditional' chemistry and physics courses."

From a study of these reports of experiences with nine programs of modified physical science, certain inferences and conclusions seem to be justified:

1. The high school physical sciences, at long last, are yielding to the forces which are bringing about a reconstruction of the secondary school curriculum. There is apparent a shift in emphasis from concern for subject matter itself to concern for the learner. We cannot say that the rate of change is great, but sincere efforts at modification are to be found in all sectors of the country and in all types of schools. These efforts, in the main, have taken the form of classroom experimentation rather than controlled research. Attempts have been made to evaluate results, but the methods employed have not been objective or statistical in character; their validity and resultant conclusions are open to question.

2. No clear-cut pattern for the modified course, or courses, has as yet evolved. Some courses consist of apparently unrelated blocks of subject matter, and there is little evidence, in so far as the course outlines indicate, of any integrating or unifying theme. On the other hand, there is general agreement on the desirability of such integration, and it may be assumed that the methods of instruction employed point in this direction, possibly with considerable success.

3. The proper role of the textbook in a modified course is not clear. It is generally agreed that presently available textbooks are far from satisfactory. To the extent that the course has its roots in personal and community problems, the textbook becomes less important as "the guide" to the course and becomes, simply, one more resource for teaching and learning. Possibly an entirely new concept in textbook design is needed if this long-established educational tool is to make its best contribution to modified physical science courses.

4. There is uncertainty regarding laboratory work in the modified courses. How much and what kinds of laboratory work continue to be perplexing problems. There is general agreement on the desirability of providing opportunities for individual and group activities, but how to adapt the "laboratory" of conventional chemistry and physics to more functional purposes is the problem. Again, possibly we need to devise a set of almost entirely new kinds of laboratory experiences.

5. There is general agreement on the desirability of providing for field trips and for making use of outdoor, human, and industrial and technological resources in the teaching of modified courses. However, the big problem is to find time for this type activity.

6. It appears probable that the majority of these courses have been developed by classroom teachers who have received no special time allotment for such work; the work has been done at the end of a busy day, during evenings, over weekends, and during vacation times. However, there are encouraging reports of the use of county and local workshops devoted specifically to problems inherent in developing modified courses.

7. It appears that the teacher is a "key" factor in the success of a modified course. Some teachers approach the course with enthusiasm, intrigued by its tremendous possibilities; others seem overwhelmed by the multitude of problems arising out of departure from the conventional.

8. Educators responsible for programs of science education generally agree that the teacher-education programs of many training institutions fail to produce the kind of teachers needed for the newer physical science courses. The inadequacies of pre-service education make all the greater the need for in-service education and assistance.

9. In most of the courses reported in this symposium, the "units" or "areas" as outlined are regarded more in the nature of resources or guides than as an inflexible "blueprint" for the course.

10. Many modified courses in physical science have been approved for college entrance credit by higher institutions of recognized standing.

What—Collect in Winter, Too?

By JAMES A. STARKEY
Head of Science Department
Senior High School, Vineland, New Jersey

CERTAINLY; WHY NOT? A field trip to collect specimens of aquatic life from nearby streams is always a profitable activity for both teacher and pupils. And the winter field trip is especially interesting. If you are going to keep the live specimens in laboratory aquaria, collect them from the slowly moving waters of quiet streams. A dipnet, a screen with fine mesh, a bucket, and some wide mouth bottles are the necessary equipment.

Passing the dipnet through the aquatic plants with a shaking motion, picking up a minimum of mud, will usually result in a good haul. Examine the material immediately if time permits. The net may be upset into the screen and as the water drains out much movement will be noticed among the debris.

As the various specimens appear place them in the bottles made ready for this use. It is better not to mix the various kinds of life in these small containers. Insects such as the whirligigs (*gyrinidae*) and diving beetles (*acilius*), and the water bugs (*zaitha*) would, by their rapid movements, destroy the more fragile insects and larva. Minnows and tadpoles may be placed together. Salamanders, shrimp (*palaemonetes* and *crago*), and crayfish are better kept separately.

Broken plants, old leaves, and other such material should be examined carefully for snails (*physa, lymnaea, planorbis*) and caddis worms (*molanna, platyphylax, neuronia*), which may be clinging to them. Don't overlook the water scorpion (*ranatra*) which simulates a twig; it is easy to miss if it does not move. Run additional water through the screen to separate the debris and wash away any mud. Smaller forms will show up in this process.

Tiny clams, (*sphaerium* and *pisidium*) and the larger snails (*campeloma*) are usually found in the nets which include some of the soft mud. The leeches with their muscular suckers are usually present. Many larval forms of fish flies (*chauliodes*), orl flies (*sialis*), and midges (*chironomus*) will be found by careful examination of the washed material. Nymphs of the dragonflies, damselflies, mayflies, and stoneflies will be found in large numbers.

The water boatman (*corixa*) and the back swimmers (*notonecta* and *buenoa*) are interesting insects always found in large numbers. The creeping water bug (*pelocoris*) is occasionally present. A small crustacean, the water asel (*asellus*), is another common form.

If lack of time prevents immediate examination in the field, several hauls with the net may be emptied into a bucket and examined later. Identification should be attempted before the specimens are released in the aquarium. Any good key for aquatic life and a dissecting microscope will make identification easy.

Since all of these specimens are collected from the same area, they may all be placed in the same aquarium. Their activities in the aquarium will be the same as though they were still in their original home.

Minnows and tadpoles, small crayfish and shrimp will live well together. All do well on dry rolled oats supplied occasionally. The snails will feed on the plants or on the algae which grow on the glass. Several caddis worms will be interesting in the variety of their cases, which they continue to enlarge.

The adult insects of this collection are all predators, and the various larval should be introduced freely to supply food for them and the other larger specimens. However, this population cannot be selfsustaining as in the natural habitat, and other food must be supplied. Chopped earthworms or sow bugs may be used. The latter can be found any time of the year, even in winter, and all the meat eaters of the aquarium will feed on them.

Study Science Where It Is Found

By **ELMER HEADLEE**
Head of Science Department
High School, Kirkwood, Missouri

and

NORMAN R. D. JONES
Teacher of Biology
Southwest High School, St. Louis

THE MAIN THESIS of this article is this: there are many educational advantages to be gained by *taking* students to where science is found, as opposed to *giving* students a neatly-packaged course all wrapped up in a textbook, flavored with some "cookbook" experiments, and delivered within the four walls of a classroom. To illustrate, we shall describe some of our experiences with the St. Louis Science Summer School of 1950.

Three independent factors with only tenuous relations induced the idea of the Science Summer School. (1) St. Louis does not have free public summer schools, and no science is offered in the "private" schools as conducted by public school teachers with course accreditation by the Board of Education. (2) Students like the activity side of science instruction very much, as evidenced by their participation in science fairs, science weekend excursions, science experiences in summer camps, etc. (3) There is a growing recognition of the potential values in a program of education that is closely tied up with the individual students' problems and with the life of the community—call it life-adjustment education, or resource-use education, or what you will.

> Here is a group of three articles that offer practical suggestions for interest-getting approaches to science teaching. There are implications for all grade levels in both biological and physical aspects. The authors have used these ideas successfully in their own teaching and offer them for consideration by other teachers.
>
> Mr. Starkey is head of science education in the Vineland, New Jersey, public schools. He teaches chemistry in the high school and is currently a member of the NSTA committee on school facilities for science instruction.
>
> Mr. Headlee teaches chemistry in Kirkwood, Missouri, High School. "Rocks and minerals" are his hobby, and his collection has come from all parts of this country. He is active in NSTA affairs, having served on the Board of Directors and as chairman of the nominating committee.
>
> Mr. Jones teaches biology in Southwest High School, St. Louis. He is a past-president of NSTA and is now in the midst of a term on the Board of Directors.
>
> Mr. Panush (article, page 25) teaches earth science and also chemistry in Central High School, Detroit. He is widely known for his excellent journal, *Metropolitan Detroit Science Review,* which he owns, edits, and publishes.

The authors had had considerable experience with a number of "new ideas" for teaching science and, once the Science Summer School idea was triggered, were anxious to experiment with it. There were certain first steps to be taken to make it possible. In the first place, it should be a fully accredited course. To meet the time requirement of 80 clock-hours and still allow for extended field trips, excursions, and plant visitations, a time schedule of eight hours a day, five days a week, for two weeks was proposed. Basic "course content" was to include visits to representative St. Louis industries, the parks, Shaw's botanical garden, the zoo, the Rockwood reservation, and conservation projects, along with certain other activities such as bird walks and a weekend camping experience. These proposals were placed before the proper school authorities, and, in due time, approval was granted by the St. Louis Board of Education, the Missouri State Department of Education, and the North Central Association.

Thorough planning was necessary. Advance publicity was distributed. When opening day of the Science Summer School arrived, the enrollment was nearly double what had been anticipated. Arrangements had been completed for all con-

tacts, excursions, and visitations. We were ready to go.

Since one of our main objectives was "to see and understand the science in action around us," we agreed to keep careful records as an aid to sharpening our powers of observation. Prepared record cards were passed out to the students, and these they filled out as the "course" progressed. The cards carried columns and headings as follows.

WEEDS: *Name; Habitat; Harmful Characteristics; Color of Flower; Size.* FLOWERS: *Name; Habitat; Color; Economic Value.* TREES: *Type of leaf; Flower; Fruit or Seed; Size, Shape, Bark; Economic Value.* BIRDS: *Name; Color Markings; Characteristics; Habitat; Economic Value.*

Now for a quick review of some of our outstanding "lessons." We visited a dairy, and the large number and variety of its products, together with all the science involved, were most enlightening. Pasteurization, homogenization, irradiation, and sterilization were technical terms "brought to life." At the Ralston Purina Company laboratory we saw how studies of animal feeds are carried on, including the determination of food value content, studies of deficiency diseases, examination of diseased animals brought in by farmers, the development and testing of food formulas, etc. Problems of milling, transportation within the plant, packaging, and shipping the final products took on new or added importance in the eyes of students.

In all these visits, it should be pointed out, there were compelling lessons to the effect that science in use is not compartmentalized. Techniques and principles from both biological and physical science interwoven in a larger complex were to be seen. Also, the complex often included more than just "science" in order to keep the total operation functioning.

At a power plant we traced the transformations of energy from coal to steam, to turbine, to generator, to transformer, and thence to consumers.

At an ice plant we saw condensers and compressors at work as they "pumped" energy through a cycle involving changes of state among solids, liquids, and gases.

We watched the processing of corn in a starch and sirup plant, and saw the raw material come out as fiber, gluten, starch, and germ (oils). Digestion on a huge scale converted much of the starch to sugar (sirup). In a steel fabricating plant mechanical drawing, mathematics, pattern-making, and machine work were thoroughly integrated for the accomplishment of a specific goal. Many principles of physics entered into the operations which concluded with the spraying of the end product with a protective paint.

Students demonstrated their interest and understanding in various situations by the questions they asked, the reports they wrote, and the manner in which they participated in the group discussions of the visits afterward. As many of them remarked, even the conversational periods did not seem "classroomish."

Another valuable experience was a taste of camp life. Because of costs involved, many students cannot spend even two weeks in a summer camp. And, it might be added, many such camps do not take advantage of the wealth of science teaching opportunities in their immediate vicinities. Through our Science Summer School and the authors' previous connections with the Boy Scout organization, a two-day camping trip (overnight) was arranged. Each student provided his own food, and bus transportation was only a dollar. Brief though it was, this camping experience was new to most of the students and afforded numerous opportunities for instruction in science: preparing a camp site; providing for sanitation; building, using, and putting out fires; first-hand studies of plant life, insects, and rocks—and the sky at night; close-up observation of reforestation and soil conservation practices; and still others that could be mentioned if space permitted.

If this article has merit, it likely will be in helping stimulate ideas on the part of other science teachers. It is doubtful whether anyone knows the best way to teach science for its general educational values. Yet there has been much emphasis on this function of science in recent years, and much remains to be learned as to the relative merits and effectiveness of the various approaches. If we were to offer some advice, it would take such form as this: Do not be afraid of ideas which would lift science teaching out of the traditional patterns. Do not hold back on trying some of your ideas for fear of failure; discouragements and failures are to be expected—along with the encouragements and successes. Crystallize your ideas into a workable plan which can be presented to the responsible heads of your educational system. You may be surprised at the alacrity with which they "take you up" on it. And, after you've tried out your ideas, expressions of satisfactions will almost certainly come from many sources. Also—many ideas and suggestions for improvement the next time. (EDITOR'S NOTE. And be sure to report your experiences through *The Science Teacher.*)

Term Reports in Earth Science

By LOUIS PANUSH
Science Instructor
Central High School, Detroit, Michigan

EARTH SCIENCE, or physiography, as taught in Central High School is a one-semester course elected primarily by students in the junior or senior year. It is popular with both college and non-college preparatory students, with boys as well as girls. In such classes, consisting of students of different scientific backgrounds, of varying abilities and interests—college-preparatory students who earned good grades in biology, physics, or chemistry and less-gifted general students who had difficulty with general biology and/or physical science—the use of projects, term papers, and supplementary materials has proved helpful and of definite educational value.

In order to provide for individual differences, to enable all to have the satisfaction of some accomplishment in the class, and to provide the more talented students with an opportunity to tax their intelligence and ability, this teacher requires *all* students to hand in a term paper or a project, in addition to the other general requirements. At the beginning of the semester, after a general introduction to the subject, the students are told of the term paper or project which they must hand in at a certain date. A comprehensive list of topics for term papers[1] is posted on the bulletin board. The students are to make their tentative choices by the end of the second week. They are allowed to make changes in their topics, choose only one phase of the subject, or suggest topics of their own during the first four or six weeks of the term. Afterwards, changes are rarely permitted.

A definite date is set for the completion and handing in of the papers, usually at the end of the 14th week of the term. However, students are encouraged to hand them in as early as possible so that reports on their papers or projects may be given before the class at suitable times. It is possible to plan such reports to fit in with class assignments and recitations, thus obtaining additional value both for the individual student and the class.

Reports are required to be written clearly in ink, or preferably typewritten, to have an appropriate cover, table of contents, drawings, tables, diagrams, maps, references, and pictures, whenever possible. Originality is encouraged in design of cover, in presentation of main theme, in use and distribution of diagrams and pictures, and in the general set-up of the paper. However, it is constantly emphasized that the report must be written clearly and simply so that anyone—who knows no more about the subject than the writer did before he started it—will understand it and read it with interest. Although a minimum length of 1500 words is required, emphasis is placed on quality, not quantity, of the report. Also, it is pointed out that a paper project is not merely to satisfy the instructor's requirement but to give great satisfaction to the student—to make him feel that he has done credit to himself, that he has gained something valuable out of the work and time that he spent on it, and that he has produced something worthwhile to present before the class.

Below is a partial list of topics for term papers which this writer has compiled and used, with constant revisions, for the past few years. Subjects not elected by students for several consecutive terms are dropped from the list, and others—sometimes suggested by the students—are added. A topic can be chosen by only one individual per term. Term papers are retained by the instructor for at least one semester in order to prevent collusion among students.

This list, restricted primarily to topics which have a direct connection with the textbook and class work, is far from complete. No claim is made for originality; the subjects were compiled from many sources: textbooks in astronomy, geology, mineralogy, meteorolgy, physics, and chemistry; lists compiled by teachers who have had previous experience with the course; magazine articles, newspapers, etc. It is offered, in good faith, to teachers of physiography and allied subjects who may want to use it according to conditions prevailing in their schools and classes. It is hoped that they will find it a satisfactory source of supplementary ideas for more and better topics for term papers or for class reports. Additional suggestions will be sent on request to the author.

(*For* SUGGESTED TOPICS, *see page 51.*)

[1] For the past two years the author emphasized term papers instead of other projects. It is these that he is dealing with in this article. About ten per cent of the students submitted other types of approved projects.

MILWAUKEE JOURNAL Photo

Still Busy With Research at 92!

By JAMES R. IRVING
Pure Oil Company
Crystal Lake, Illinois

LET'S get one point straight at the very beginning. Mr. R. W. Vicarey, Milwaukee scientist and traction-battery authority, isn't an old man despite the fact that he's getting on toward 93. It's true that he retired at the age of 89 from his active duties as chief chemist and superintendent of Globe-Union, Inc., Milwaukee, manufacturers of storage batteries and other electrical equipment, but inquisitive minds just can't be retired that easily.

Mr. Vicarey's interest in science and research comes naturally. He was a relative by marriage to one of England's and the world's most outstanding scientists, Michael Faraday, for whom he holds the greatest admiration and respect to this day. Vic's first scientific experience at the age of nine was as Faraday's bottle washer and chore boy at the Royal Polytechnic of London, England, in 1867. Vicarey recalls that the bottles were really not glass but crude clay containers, and his manual labor consisted of turning Faraday's historic electrostatic machine, a source of electrical energy, and providing compressed air for Faraday's many experiments by pumping blacksmith's bellows. Trimming wicks and supplying candles, the early laboratory's only source of heat for experiments, are also among his memories.

Four years after he was born in Devonshire, England, 1858—"a Londoner by rights"—Vicarey's parents separated. Vic's early life was spent being shuttled from relative to relative throughout the city of London. Yet, he may never have become infected with scientific zeal and an inquisitive mind had it not been for one of these farming-out stays with relatives. For one of Vicarey's relatives was Michael Faraday.

And therein lies the real story of over 80 continuous years of scientific experience—certainly more than a lifetime for most investigators. Maybe just to work in the same room with a man who is

> Rare indeed is the opportunity to meet and talk with a man whose experiences in science have included intimate, personal contact with "great names" that we tend to associate with an age gone by. That is what James Irving thought when he read a *Milwaukee Journal* account of R. W. Vicarey. Moreover, he decided to meet Mr. Vicarey and write a story about this man for the science teachers of America. We are glad he did—and here is the story.
>
> About Irving himself: he was a high school teacher of chemistry for more than ten years and became chairman of the science department in the Des Plaines, Illinois, high school, serving another half dozen years in this capacity. In 1949 he accepted a position as administrative assistant in the research and development laboratories of the Pure Oil Company. He has continued his membership and active interest in NSTA, saying, "I am still fundamentally a teacher."

today responsible for hundreds of world-shaping scientific discoveries and probably best known for his theories of electromagnetic induction which gave rise to the electric generator and today's electric motor—foundational to our age of electricity—should have been enough for young Vicarey. Perhaps it was Faraday's recollections of his own youthful days as apprentice to Sir Humphrey Davy, another outstanding English scientist, that helped him to understand nine-year old Vic. In any event, Robert William Vicarey's interest "caught fire."

Today, in his home on Bremen Street, in Milwaukee, Mr. Vicarey gently puffs on his cigar—he smokes a box and a half a week—and recalls how he enlisted in the British Navy at the age of 14. He paid a London applewoman a small sum to swear she was his mother and give her permission for him to join the British sea forces of 1872. Because of his experience, the navy put him into the electrical school where he first studied and worked with the secondary or storage battery. He proudly recalls that the first English ship to go to sea with storage battery equipment found him aboard. His classmates in the electrical school at the time were Prince Albert and Prince George of Wales (the late King George) who were training as young officers in the Navy.

In 1886 Vic joined a prominent London electrical company and installed batteries with plates 14 feet square. Single plates weighed more than a ton. A step ladder was required to get into the cells, and the battery had a capacity of 12,000 ampere-hours.

In 1907 Vic came to America on a battery project for the New York Third Avenue Railway. He's proud to relate, too, that in 1908 a battery-equipped pleasure car attained a speed of 118 miles per hour on a measured five-mile track—eight years before cars powered with gasoline motors passed the "100" mark. Mr. Vicarey joined the Globe Union Company in 1923 as chief chemist and assumed added responsibilities as production superintendent in 1925.

Mr. Vicarey modestly follows up this story of his experience and contributions with the statement that he never attended college or took a degree in his life. But what college-trained investigator wouldn't be willing to swap his "higher" education for any five years' experience out of Vic's "four score"?

At the moment Vic might be working on any one of many research projects. Ever since he worked in London as an assistant to Nikola Tesla, world famous electrical wizard, in lighting the interior of a London church without a single bulb or wire being present, the subject of lighting has intrigued him. He'd like to put some of Tesla's original ideas to practical use today.

The subject of radium, too, is always sure to bring a twinkle to the eyes of Mr. Vicarey. Vic has studied radium and its properties for a number of years and is still anxious to find the answer to one of Fermi's experiments he witnessed as a youth in Italy on one of his visits. A piece of radium was used as the source of energy to power a fan for 40 minutes—a radium motor. (This Italian scientist, by the way, was the father of the now internationally famous Enrico Fermi, University of Chicago nuclear scientist.) You see Fermi never did explain his experiment that day. He only demonstrated it. But Vic knows it's possible because he saw the "motor" work. Perhaps Vic has a point, too, when he says, "the real fruits of nuclear energy are still about 100 years off."

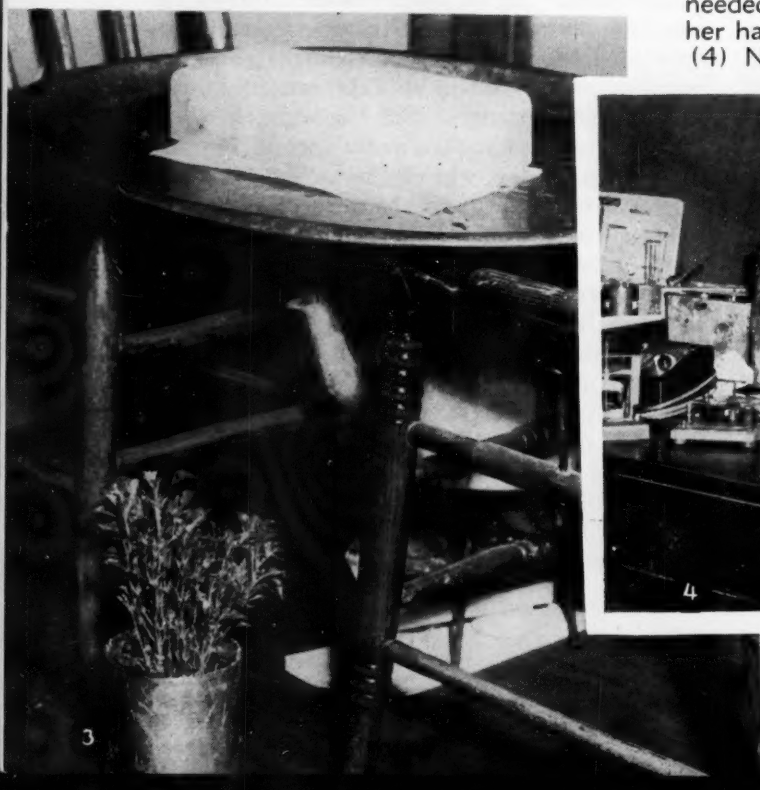
This, then, is a partial picture of a man who has spent more than 80 years furiously engaged in scientific research. Spending some time with a man like Robert William Vicarey is a tonic for anyone, whether interested in scientific research or not. Nurtured in the history and the cultural romance of the past, Vic is constantly in tune with the world of 1950. When it was suggested that he accept the invitation of his daughter out East to come and live with her—"Move out there," said 92-year-old R. W. Vicarey, "Impossible! What would become of my research?"

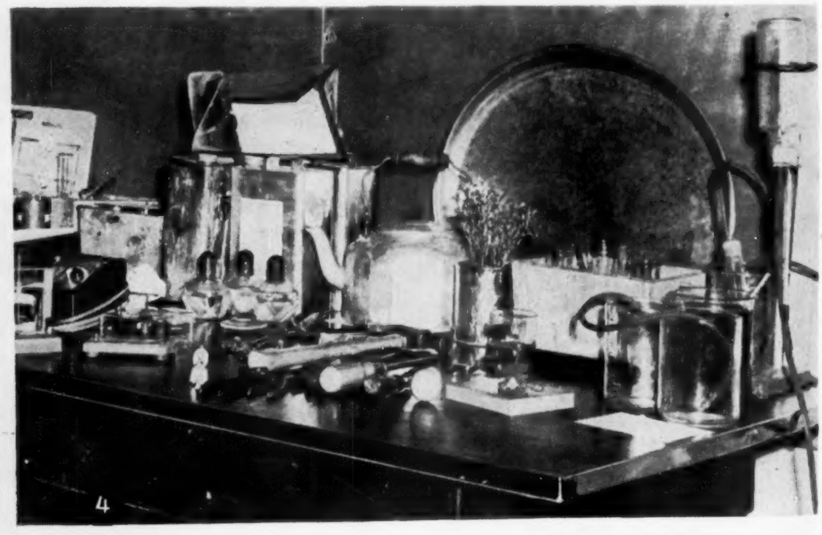
NSTA To Study Facilities For Science Instruction

The National Science Teachers Association announces the receipt of grants in aid in the sum of $4500 to be used for the development of one or more publications to help science teachers and school leaders in planning new and remodeled facilities for science instruction.

The project will provide opportunities to consider school buildings, science rooms, outdoor study areas, furnishings, equipment, supplies, and other aspects of physical facilities for effective science instruction in the elementary and secondary schools of the nation. It is expected that the project will involve extensive cooperation of science teachers, school administrators, school architects, manufacturers, and others interested in this problem area.

NSTA helped provide science experiences for elementary teachers who went "back to school" for a one-day conference held October 14 at Millersville, Pennsylvania, State Teachers College. An annual affair, this conference was attended by over 300 teachers who came entirely on their own time and at their own expense. A.M. sessions consisted of a dozen one-and-one-half-hour "workshops" devoted to a variety of subjects. The science workshop, arranged and conducted by John Roth, supervisor of teacher training in science at the college, and NSTA Executive Secretary Robert H. Carleton, drew 35 teachers. Working in small groups, they tried 15 experiments. Said the teachers after it was all over, "Practical and most helpful experience in a long while." Chief complaint: "We didn't have enough time to do all we'd like to do." (1) Evelyn Schiffstall brings in more simple materials and equipment for later use in science experiences. Student teachers had "scavenger hunt" day before the conference, rounding up materials listed on cards previously prepared by Carleton. (2) Catherine Mowrer takes needed materials from table. Note card of instructions in her hand. (3) The rain cycle attracted much attention. (4) Notice how simple the equipment is! College lab-





COMMITTEE ON SCHOOL SCIENCE FACILITIES
1201 Sixteenth St. N. W., Washington 6, D. C.

REPORT ON SCHOOL AND COMMUNITY FACILITIES FOR SCIENCE INSTRUCTION

EXPLANATION: Each member of the Association is asked to help find real examples of features that make science instruction effective and practicable. Attention is focused in this inquiry on desirable and good features. Since you are an active science teacher, you are the best judge of what there is in your school and school community - or one that you know about - that is worthy of careful consideration by the committee responsible for this study.

The inquiry is concerned with the location and arrangement of rooms; room furnishings including tables, chairs, cabinets, cases, windows, and the like; apparatus, equipment, and supplies for science instruction; special rooms and features such as darkrooms, greenhouses, museums, offices, weather stations; outdoor facilities such as nature trails, gardens, camps, and forests.

NOTE CAREFULLY: Are there one or more features in your school or community that you consider to be especially good or outstanding facilities for science instruction? Check ONE: ____YES ____UNCERTAIN ____NO. If you have checked a clear NO, stop here and do not complete and return this form. If you have checked YES or UNCERTAIN, please indicate desirable features either individually or in consultation with other science teachers. Mail form to address given above. Please do so as promptly as practicable.

BASIC DATA ABOUT YOU AND THE SCHOOL FOR WHICH REPORT IS MADE

1. Name of school________________________ Street address________________

   City________________________ Zone____ State________________________

2. Grades in this school (circle): K 1 2 3 4 5 6 7 8 9 10 11 12 13 14

3. Total number of pupils enrolled in this school (write in): ________________

4. What is dominant nature of the community from which the school's pupils come?

   (Check ONE): ____Factory; ____Business; ____Rural; ____Residential; (IF OTHER, NAME OR DESCRIBE) ________________________________

5. About what year were the science rooms built or remodeled? (Indicate for each of the following the most recent date of construction and/or remodeling.)

	Built	Remodeled		Built	Remodeled
Elementary school science	19__	19__	Chemistry	19__	19__
General science.	19__	19__	Physics	19__	19__
Biology.	19__	19__	________________. .	19__	19__

6. Your name____________________________ How long in this school? ________ (years)

7. Your major field (write in): ________________ (based on teaching) ________________ (based on study)

8. Subjects you now teach (write in): ________________; ________________;

   ________________; ________________; ________________

(PLEASE CONTINUE ON NEXT PAGE)

INVENTORY OF GOOD OR OUTSTANDING FACILITIES FOR SCIENCE INSTRUCTION

NOTE: Detailed descriptions are not necessary now. You should report on only the good or unusual features that you have in or available to your school. Check the general usefulness of each such feature. Please overlook all features that are absent, poor, or mediocre. Rate only items with which you are familiar. Descriptive remarks on page 4 about especially desirable features will be very helpful to the committee.

Check (X) in these columns to indicate general usefulness of the science facilities you have in your school.

FIRST, BE SURE TO READ THROUGH ENTIRE LIST ON PAGES 2 AND 3. THEN ADD OMITTED FEATURES IN APPROPRIATE PLACES. RATE THE GOOD OR OUTSTANDING FEATURES OF YOUR SCHOOL.

GROUP I. Subject areas of features	GOOD	OUT-STANDING
A. Elementary school science features:		
1. Regular classroom with some science provisions.	___	___
2. Special room equipped for science experiences	___	___
3. Cabinets for science apparatus and supplies	___	___
4. A school storeroom for science materials.	___	___
(Add features): ________________	___	___
________________	___	___
B. General science features:		
5. General science classroom or classrooms	___	___
6. General science laboratory room	___	___
7. Combined general science class and laboratory room. . . .	___	___
8. Combined general science and biology room or rooms. . . .	___	___
9. A distinct general science storeroom.	___	___
10. A general science room for trying out demonstrations. . .	___	___
11. Plant and/or animal room for general science.	___	___
(Add features): ________________	___	___
________________	___	___
C. Biology features:		
12. Biology classroom or classrooms	___	___
13. Biology laboratory room or rooms.	___	___
14. Combined biology classroom and laboratory	___	___
15. Combined biology and general science rooms.	___	___
16. A distinct storeroom for biology materials.	___	___
17. A separate room for pupil and teacher project work. . . .	___	___
18. Plant and/or animal room for biology.	___	___
(Add features): ________________	___	___
________________	___	___
D. Chemistry features:		
19. Chemistry classroom or classrooms	___	___
20. Chemistry laboratory room (standard type)	___	___
21. Chemistry laboratory room (semimicro type).	___	___
22. Combined chemistry classroom and laboratory	___	___
23. A distinct storeroom for chemistry materials.	___	___
24. A separate room for trying out chemistry experiments. . .	___	___
25. A balance or weighing room for chemistry.	___	___
26. Combined chemistry and physics room or rooms.	___	___
(Add features): ________________	___	___
________________	___	___

E. Physics features:

27. Physics classroom or classrooms. . . . . ______ ______
28. Physics laboratory room. ______ ______
29. Combined physics classroom and laboratory. . . . . ______ ______
30. Combined physics and chemistry room or rooms . . . . ______ ______
31. A distinct storeroom for physics materials . . . . ______ ______
32. Combined physics and chemistry storeroom . . . . ______ ______
33. A separate room for trying out physics experiments . . . . . . ______ ______

(Add features):______________________________________ ______ ______

______________________________________ ______ ______

GROUP II. General features for science

F. Special or additional school science facilities:

34. A classroom and/or laboratory for all sciences . . . . ______ ______
35. A storeroom serving all the sciences . . . . ______ ______
36. A preparation room serving all the sciences. . . . . ______ ______
37. A photographic darkroom or darkrooms . . . . ______ ______
38. A specially equipped projection room . . . . ______ ______
39. Classroom space for science books and pamphlets. . . . . . . ______ ______
40. A separate science library . . . . ______ ______
41. A museum with science materials. . . . . ______ ______
42. A weather observation station. . . . . ______ ______
43. An applied science work area with tools. . . . . ______ ______
44. Built-in aquaria and/or terraria . . . . ______ ______
45. An all-school greenhouse . . . . ______ ______
46. An all-school animal rearing room. . . . . ______ ______
47. A school forest. . . . . ______ ______
48. A school camp. . . . . ______ ______
49. A school operated farm . . . . ______ ______
50. School gardens . . . . ______ ______
51. A school nature trail. ______ ______

(Add features):______________________________________ ______ ______

______________________________________ ______ ______

G. General features about science rooms:

52. Communication system for radio, records, school messages . . ______ ______
53. Unusual window arrangements. . . . . ______ ______
54. Means for darkening science rooms. . . . . ______ ______
55. Unusual artificial illumination. . . . . ______ ______
56. Classroom storage cases and cabinets . . . . ______ ______
57. Acoustic treatment in science rooms. . . . . ______ ______
58. Semi-permanent or movable walls. . . . . ______ ______
59. Classroom display space or cases . . . . ______ ______
60. Corridor display space or cases. . . . . ______ ______
61. Bulletin boards. . . . . ______ ______
62. Unusual floor treatment. . . . . ______ ______
63. Exhaust fan or fume hood . . . . ______ ______
64. Unusual decorative treatment . . . . ______ ______
65. Television receiver. . . . . ______ ______

(Add features):______________________________________ ______ ______

______________________________________ ______ ______

(PLEASE CONTINUE ON NEXT PAGE)

H. Describe one or two especially desirable science features in your school or community. Please be alert to improvised devices, cabinets, chart facilities, display areas, and the like, as well as the more customary features. (Use additional paper and include a sketch as necessary.)

____

____

____

____

____

____

I. List two or three science facilities you DO NOT HAVE but which you would include in plans for building or remodeling science facilities in your school.

____

____

____

____

J. Give names and addresses of persons who could provide information about outstanding science facilities in other schools.

Name______________________	Name______________________
School____________________	School____________________
Address___________________	Address___________________
City__________ State__________	City__________ State__________

K. Give here words of caution and general remarks that may help the committee to avoid serious mistakes in the preparation of a report to aid the improvement of facilities for science instruction. (Use additional paper as necessary.)

____

____

____

____

L. Are you willing to provide additional information concerning facilities for science instruction in your school and community? (Check): _____YES; _____NO

M. Would you like to participate in a conference for the discussion of school facilities for science instruction? (Check): _____YES; _____PROBABLY; _____NO

Please Return This Form To The Address Given At The Top Of Page 1

THANK YOU!

oratory school's lack of gas was turned to advantage, and alcohol burners were used since most workshop participants came from rural one-room schools. (5) John Crabtree has just built an electric motor out of wood, wire, spikes, corks, a test tube, and some cellophane Scotch tape. (6) Rosanna Higgins puzzles over explanation of self-starting siphon. (7) Purification of water by distillation was demonstrated by Joanne Fehl and Gladys Palmer. Why so serious, Gladys? (8) Groups used 45 minutes to try out experiments themselves, then spent next 40 minutes demonstrating and discussing experiments. When, where, and how to use each experience in elementary teaching were chief questions. (9) Last five minutes were used for evaluation. Carleton (left) asks for constructive criticisms as Joseph Torchia, laboratory school instructor, passes out evaluation sheets. (10) Aftermath —"students" have gone to lunch, leaving disordered room and equipment to Roth, Torchia, and Carleton for further attention.—(Reported by Hobart Sapp, elementary science teacher, Cape May, New Jersey. Photographs by Bernard R. Hartz, graduating senior, Millersville State Teachers College.)

Open up That Golden Gate

"Urgent Problems in Science Teaching" will be under consideration when NSTA convenes in San Francisco on June 28 for the four-day annual summer meeting. During this working conference emphasis will be placed on such questions as, "What are the responsibilities and opportunities for science teaching in the mobilization of education for national defense?"; "How can traditional science content be adjusted to the newer trends in science education?"; and "What methods can science teachers use to help pupils develop skill in problem solving and critical thinking?"

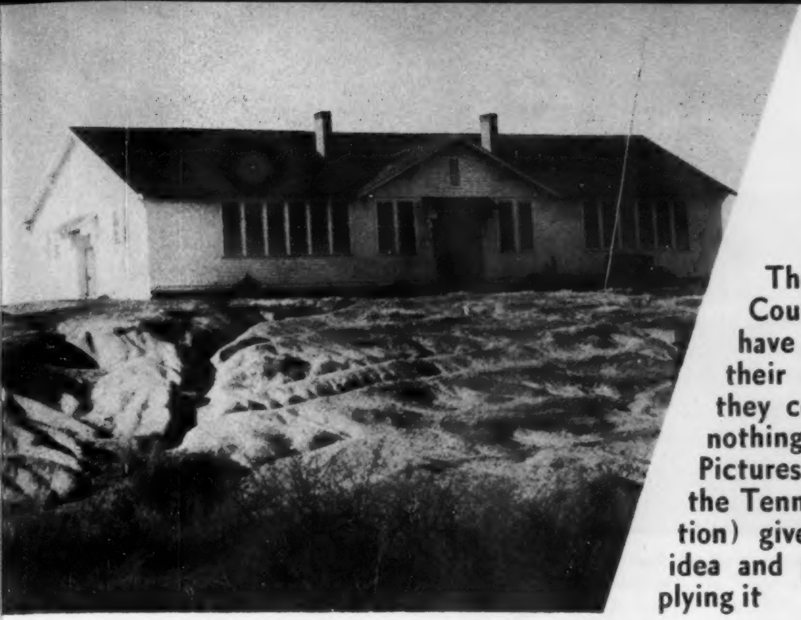
Being planned by the newly-formed NSTA Business-Industry Section, the program on Thursday, June 28, will be built around the part industry can play in making science teaching more effective. Conference registration and assignment to groups will take place in the afternoon, and the day's activities will conclude with a "get-acquainted" social.

Friday's program will include the conference keynote address, discussion group meetings, and a special banquet and dinner speaker. Discussion groups will continue their meetings on Saturday morning, and, following luncheon, summaries will be presented and resolutions drawn up.

Field trips to points of interest in the San Francisco area are being planned for conference off-hours and for Sunday, July 1, just prior to the opening of the NEA Representative Assembly (July 1–7, San Francisco). The NSTA Board of Directors will also meet on Sunday. Miss Archie Maclean, supervisor of science education, Curriculum Division, Los Angeles city schools, is general chairman for the conference.

As we go to press it has been confirmed that the meeting will be held on the campus of Mills College, Oakland (half-hour's drive from San Francisco). This will make possible dormitories, meal facilities, and meeting rooms all in one convenient location.

Proof that it can be done. Referring, of course, to "A Tin Can Planetarium" in last November's issue of **The Science Teacher.** Proudly displaying her finished work is Marilyn Palmer, eighth grader at Irving Junior High School in Lincoln, Nebraska. Her teacher is Henry Goebel. (For those who missed it, reprints of "A Tin Can Planetarium" are available from NSTA headquarters, 25 cents each.)



The Tennessee youngsters in Campaign County who reclaimed their school grounds have a more vital interest in soil erosion in their communities than they would had they continued to stay indoors and give nothing but lip service to conservation. Pictures in the accompanying article (by the Tennessee Department of Conservation) give the philosophy back of this idea and practical suggestions for applying it

Conservation Education In Elementary Schools

By HELEN B. ROSS
Associate Professor of Biology
State Teachers College
Fitchburg, Massachusetts

CONSERVATION, like many other things, begins at home. Educators today generally agree that the child learns best by starting with the things in his own immediate environment and moving from them to the larger environments of the state, region, nation, and world. Therefore, there can be no prescribed course of study in conservation which is equally applicable to all areas.

The black waters of the little creek that flow past the school ground is a much better starting place than the dust storms that occurred hundreds of miles away some years before. On the other hand, in the dust bowl region wind erosion is a much better starting place than the floods of the Mississippi. There will be exceptions to this, too. In times of disasters which assume national significance a class may be vitally interested in the news items of the occurrence. This, then, might be a good starting place, providing the lesson eventually returns to the home community and its problems.

The organization of the soil conservation district in the locality is a better place to start than the wastefulness of the pioneers. In fact, *a program based on the errors of others is not a sound program.* It is easy to criticize what others have done in the past. It is harder to face facts of the present.

There is much disagreement concerning the teaching of wise use of school supplies and proper regard for school property. Some state courses of study include it. Some do not. Ward Beard, in *Teaching of Conservation*, does not include it. He feels that the amount saved in this way is not important and that it is confusing the issue. James Tippett, author of *Paths to Conservation*, feels that it is essential; that children are naturally self-centered, that they need to be taught respect for property, that they need to be educated to avoid waste at all levels.

Actually, if conservation means wise use, it would seem to be equally applicable at two levels: the producer level and the consumer level.

A school program that taught only wise use of property could not be said to be doing a complete conservation job. On the other hand, a school program that approached the problem only from the producer level would not seem to be doing a complete job either. There is entirely too much of a tendency among persons today to shrug their shoulders and say, "Let the janitor clean it up"; or "Why should I worry about it? I (or my father) paid tax money for it, didn't I?" without thinking that possibly that tax money could be put to a wiser use or that taxes might be reduced if less waste took place on all levels.

Consumer education, then, would seem to be important. A young child who learns to care for his property and for public property is more likely to grow up to be a person aware of these needs. Whether we will it or not, in the last analysis

From barren grounds and ugly gullies to grass-covered slopes, the transformation is complete. A lesson in conservation that pupils have lived; an object lesson for all the community to see. Is it not reasonable to expect that as school programs become more realistic and more conscious of real problems of the community, public support for the schools is likely to increase? However, we have an associated job to do; namely, to show in a convincing way that such programs are not "fads and frills" and that in this kind of teaching "the fundamentals" are not neglected.

conservation is also a kind of stewardship—*wise use to achieve the greatest good for the greatest numbers for the longest time.*

Frequently school gardens are listed as conservation activities. School gardens may be conservation activities, but they are not necessarily so. A garden in which there is no regard for slope, erosion control, or any other conservation measures does nothing toward teaching pupils conservation. The way in which the activity is handled determines its use as a conservation measure, not the activity itself.

The same may be said for school camping programs. Youngsters may go to camp and learn many conservation techniques and facts. They may learn none.

School forests in themselves provide a conservation activity. But if the only activity involved in a school forest is a planting activity, many opportunities have been missed. There is also the danger that youngsters may get the impression that all forest conservation consists in planting.

If conservation is to be well taught, outdoor laboratories are a necessity. These need not be elaborate. Most schools have school grounds. Even big cities have parks. Cemeteries, city dumps, new houses going up, road cuts, a vacant lot, all offer opportunities to get out and see relationships of soil and water, trees and wildlife. The opportunities exist everywhere.

Three things are listed by teachers as reasons for not using outdoor laboratories. Lack of laboratories is a definite handicap. The other two are too many pupils and schedule difficulties. Both are real problems. Again, there are ways of solving them and they are being solved in many places. A sympathetic administration can do much to help in the schedule problems. If teachers can see that a trip outside of the school room may contribute real learning and make other lessons in the school room more vital, schedule difficulties can usually be ironed out.

The problem of too many pupils is an acute one. There are several solutions. First, it might be said that even large groups may be taken out successfully, if youngsters have been organized well before they leave the school room.

Sometimes a parent may be interested in helping. Sometimes with small children a responsible older pupil may be borrowed from a high school study hall. Neither of these persons may contribute to the actual teaching situation, but they may contribute to the organization and the safety angle.

Sometimes a specialist may be responsible for the teaching situation. He may be a member of the Soil Conservation Service, the county agent, a forester, a person in an industrial plant. In this instance the teacher's responsibility is organization before the trip, organization on the trip, and, as on every trip, follow-up afterwards.

Sometimes only a part of the class may take the trip. Arrangements are then made for someone to conduct the trip or for someone to take charge of the class which remains behind. Later the other part of the class may take another trip.

Grade placement, like content, will vary with the locality and existing conditions. Most courses

of study start with animals in first grade, plants in second, forests in third, and move on to soil, water, and minerals in the intermediate grades.

Many of the units in courses of study for primary grades are called conservation units, although actually they are not concerned with relationships. Learning that the robin lays four blue eggs is not a conservation concept. Learning that trees have leaves, twigs, branches, trunk, and roots is essential, but it is not a conservation concept until relationships between these facts and facts about soil and water have been developed.

As in all teaching, teaching of conservation should move from the known and familiar to the unknown. Little children generally like animals. They can see plants growing. They can learn much from them. Conservation of soils is a more advanced idea which needs to be built on other concepts. Conservation of minerals is something outside of the range of the average citizen to a large extent. It is sometimes a matter of legislation. Older children need to know about issues of this kind. But small folk are too far removed from voting to be concerned.

On the other hand, soil conservation and forest conservation may have meaning for primary grade pupils. When the floods occurred in Pullman, Washington, the second grade studied the relationship of cover crops to flood control. It was a logical study. They were moving from something that they could see in their own community, something that was affecting their own lives, into a greater understanding.

The starting place for a rural child will likewise differ from the starting place for a city child, even though they may live in the same area. A sixth grader in a rural school may learn soil-saving techniques that would not be practical to teach a city child in the same grade. On the other hand, the city pupil may learn more consumer conservation. The courses of study issued by the United States Soil Conservation Service illustrate this.

There are two schools of thought on the method for incorporating conservation education in the public school program. One recommends that it be taught as a special subject or unit in certain grades. The other recommends that it be integrated with other subject matter.

The proponents of the first method claim that in that way it is certain to be taught, that if it is integrated with other subject matter it may be omitted entirely by busy teachers who know little about conservation.

The supporters of the second method claim that conservation is not a single subject, it is a part of many subjects, and its implications are felt in many subjects. As the child sees conservation contributing in many places, he begins to realize its scope and importance. Furthermore, in school programs already crowded with many things conservation can take its place without adding to the schedule of subjects to be covered during the term.

There can be no doubt that more conservation will be taught as a special subject by a disinterested teacher than will be taught if it is integrated with other subject matter. On the other hand, the quality of the teaching may probably be questioned. All other things being equal, it would seem that the best results would be achieved with integration in many subjects.

Definitely science and social science lend themselves well to integration with conservation. Science is a tool of conservation. Conservation or lack of it helps write the economic history of a region and of its people. Soil conservation plays a part in nutrition and, consequently, in health. History has been made by conservation or lack of it. Geography is largely a matter of resources and their relationship to the people of an area.

Many hands make light work—and a mighty interesting approach to the practical study of conservation. The informed, resourceful teacher will recognize that science lies at the heart of conservation.

It is hardly necessary to mention that if conservation is taught as a part of other subjects it is less likely to be a textbook subject. Books can contribute to a unit on conservation. However, if the conservation taught is going to fit the locality, if it is going to contribute to other subject matter

fields, then no one text will be the solution. Books will serve as reference material.

This, the author realizes, is not the accepted view held by all educators. A number of persons in high educational positions and a number of state departments of education feel that the publishing of a book on conservation would solve all the educational problems. We have published textbooks on practically every other subject and have not made education functional. There seems to be no reason to believe that a text on conservation would solve any more problems. Furthermore, a number of texts on conservation have been written and are available on the market. Some of them serve admirably for reference material. But as a book to be picked up and read from cover to cover, reader style, they defeat the purpose of conservation education.

There can be no doubt, however, that materials are necessary on the local level for references uses. Some states are producing that kind of material.

The local nature of conservation is one reason why bibliographies often fail to be of assistance. The conservation problems of the farms in eastern Washington are far removed from the problems of humid western Washington. The problems of the coastal plain, of the piedmont, of the mountain region of North Carolina are each distinct. If conservation education is to be centered locally first, then no text will be able to solve the problem. Many books and pamphlets used as references may contribute. In the long run pupils and teachers must go outside of the classroom and learn.

The trip need not be far. The soil of the school ground may provide the first lesson. If the school ground is eroded and unplanted, it may serve as a basis for many lessons and activities. If it is planted, it may also provide much teaching experience.

Activities are another teaching device. The more real those activities are, the greater their value becomes. Thus, planting cover for wildlife is a better teaching experience than making a mural of a wildlife refuge. Filling a gulley on the school ground is a real experience. In doing it, children learn many techniques and a new pride in accomplishment that could never be accomplished by mere talk. Furthermore, there is likely to be much more transfer of learning to home and community situations.

A REGIONAL SCIENCE FAIR:

Organization and Values


Chambers Works (du Pont) Photo

Potential scientist or "just interested in science, that's all"? Science fairs help find them while they're young.

By GEORGE W. HAUPT
Professor of Science
New Jersey State Teachers College at Glassboro

"GETTING READY for the Fair made me interested in things about air. I found that living things need air. I wondered if anything else needed air. I wondered why airplanes stayed up in the air and how gas balloons and blimps stayed up in the air." This statement came from a fourth-grader who won a first award in the intermediate division of the Second Annual South Jersey Science Fair.

A seventh-grader and winner of a second award said, "The South Jersey Science Fair really helped me in one way. It taught me to have more faith in myself. When I put my project in the Science Fair I had no idea that I would get a prize. I didn't think that I could do it. But now I know that I, as well as anyone else, can do things worthwhile. I used to think just the smart people had a chance of winning. Now I know that plain people can win too."

Another first award winner, a 12th-grade student, said, "I found the South Jersey Science Fair most educational and inspiring. The experience of participating in it was very valuable, even if I had not been honored as I was. The prizes that I received will always be an inspiration to me. I will never forget my wonderful experiences."

These expressions typify the students' reactions to our Second Annual South Jersey Science Fair, held at Glassboro State Teachers College on April 22, 1950. Participation was open to all public, parochial, and private schools of seven counties.[1] The two major purposes of the Fair were to encourage and direct the creative activities of children and to identify scientifically-talented youth.

The Fair had two sponsors. Medals, certificates, and publicity were contributed by the E. I. du Pont de Nemours and Company through its Chambers Works at Deepwater Point. Books for prizes were donated by 14 publishers and awarded by the New Jersey Science Teachers Association. Teachers and parents commended this cooperative venture by business, industry, and education.

[1] Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, and Salem.

Planning a science fair? If so, Dr. Haupt's account of the South Jersey Regional Fair should be helpful. Rather unusual, it seems to us, is the kind of cooperative endeavor involved in this fair. It is interesting to note, too, that entrants in the fair came from all grade levels —kindergarten through senior high school.

Dr. Haupt is president-elect of the New Jersey Science Teachers Association. Science for elementary schools is his principal field of interest. He is the author of numerous articles and research reports in this connection.

Four hundred and thirty children registered 172 exhibits. Some of the exhibits represented the cooperative work of as many as 30 children. Ages of the entrants ranged from five to 18 years. Educational levels ranged from kindergarten through 12th grade. The ratio of number of children to number of exhibits indicated group participation that may have been of great value.

The program was carefully timed. Three short addresses followed the placement of exhibits. Everyone attended this half-hour assembly. Then, for an hour, the exhibit halls were opened. Next, for an hour, the halls were closed to all but the judges. While the judges examined the exhibits, visitors attended an illustrated lecture put on by the du Pont Company. Luncheon was served at noon.

Discussion Precedes Awards

After luncheon, for 45 minutes, there was a panel discussion by the New Jersey winners in the Ninth Annual Westinghouse Science Talent Search. At the conclusion of the panel discussion the judges examined the exhibits for 45 minutes. Then the halls were again opened for visitors for a period of one-and-one-half hours. When this final observation was completed, the judges were introduced, and the awards were presented.

Awards were made within four classifications. The classifications were: primary (kindergarten through grade three); intermediate (grades four through six); junior (grades seven through nine); senior (grades ten through 12). Three medals—first, second, and third awards—were allotted within each of the four classifications. Extra medals were given in the case of two ties. Books were assigned to each of the medal winners to be placed in their respective schools. Finally, each medal winner was given a certificate of excellence. Thus, each of the 14 winners was awarded a medal, a certificate of excellence, and a set of books.

Winning Topics Show Variety

The titles of the winning exhibits, listed by divisions in decreasing order of excellence (as judged), are: *Senior*: Fluorescence of Detergents; Mendel's Laws Applied to Chickens; Work of a Tree—for the Tree and for Man. *Junior*: Operation of a Plane; Improvement of Chickens; Iron Ore to Steel (tie for third place); Safety in the Home (tie for third place). *Intermediate*: Properties of Air; Physiography of Erosion; Basic Principles of Magnetism and Electricity (tie for third place); Uses of Electricity (tie for third place). *Primary*: Praying Mantis; Leaves for Five-Year Olds; The Weather. Analysis of these titles reveals an even spread for biology, a trend toward chemistry and physics in the higher divisions, and emphasis on descriptive science in the lower divisions.

Top Winner in the senior division was sent to the First National Science Fair held in Philadelphia, May 19–21, 1950. This award was made by the Press-Union newspapers of Atlantic City, New Jersey. At the National Science Fair our representative competed with 29 entrants from other parts of the United States. He was most enthusiastic concerning his contacts and experiences.

An interesting example of valuable relations possible from a Regional Fair is provided by follow-up exercises that were held at the junior high school of Bridgeton, New Jersey. On May 4, two weeks after the Fair, three Bridgeton medal winners received their awards before an assembly of the entire student body. Short addresses were made by the county superintendent of schools, the city superintendent of schools, the principal of the junior high school, a representative of the du Pont Company, and the coordinator of the South Jersey Science Fair. Several students presented vocal and instrumental selections, and the Fair participants received the congratulations of their classmates. This program was a rich and stimulating sequel to the Fair.

Resultant Values Clear

The Second Annual South Jersey Science Fair evidenced an emergence of two important values. The children's statements at the beginning of this article suggest these values. First of all, a shift of motivation was apparent.[2] Of course, the children were interested in awards—extrinsic motivation. But, without doubt, a deeper drive was working—an intrinsic motivation. Secondly, one sensed possibilities of the Science Fair exhibit as a source of data for the construction of achievement profiles.[3] Is the Science Fair a proving ground for identification of diverse abilities of children? Certainly the South Jersey Science Fair was an interesting study in transition of motivation and manifestation of differentials of ability.

---

[2] Hilgard, E. R. and Russell, D. H. "Motivation In School Learning." Chapter II. The Forty-Ninth Yearbook of the National Society For The Study of Education. Part 1. *Learning and Instruction.* 1950. The University of Chicago Press.

[3] Goodenough, F. L. *Developmental Psychology.* Chapters XIV, XV, and XVI. Appleton-Century Company. 1945.

Chats With Science Teachers—X

By HANOR A. WEBB

Professor of Chemistry and Science Education
George Peabody College for Teachers
Nashville, Tennessee

Boiled-Down Books

Do you read reviews—and similar brief treatments—of books and articles that are printed in *The Science Teacher?* Or do you pass over these paragraphs as being short, hence insignificant?

Have you called the attention of your science students to their opportunity of finding items in print that interest them through a study of reviews? Particularly, have you made use of student-written reviews as developers of skills in the reading, and writing, of science material?

Reviews and their relatives are literary inventions that have specific uses, definite forms, and special skills of the writing craft. They are of high value to persons, such as scientific workers, who must be selective in their reading. The science teacher should understand them and teach their use to budding scientists.

Two attitudes appear in the boiled-down product of a reviewer—the objective, and the subjective. The objective viewpoint is this—what's in the book? The subjective—what's good or bad about it? The objective contains only facts; the subjective adds opinions. Some books and articles, therefore, are just boiled down; others are boiled down with salt added.

The Review Family consists of (a) digests, (b) reviews, (c) abstracts, (d) annotations. This is the order of their decreasing lengths as written; it is probably the order of increasing skill to write them well.

Digests are condensations of books or articles. Nothing is to be altered except the length. An author's style is to be preserved by use of his very words. Paragraphs, perhaps pages, are omitted, but their loss must not spoil the story or the message.

The digest is therefore wholly objective. The digestor adds nothing of his own. He may smooth connections where parts have been left out, but even these must be as the author might have written them.

The most familiar digests are those of books and articles in the monthly issues of *Reader's Digest, Science Digest,* and others. These are done with consummate skill, and are worth our study.

Why are the longer books and articles written when their digests seem equally interesting and instructive? Talk this over with your students.

Reviews are the thoughtful analyses of books and articles, to determine for each its purpose and how well this purpose is fulfilled. The treatment is chiefly subjective; the reviewer should offer his judgment as to who should read the book and why. He should describe the content sufficiently to back up his advice.

A skilled reviewer knows that the book or article is almost sure to please and instruct some group of readers. He defines that group with care and praises the book *for them.* He would never commit the error of that college professor who once condemned a science book as "childish, inaccurate, elementary, and asinine." Of course the book was childish, since it was written for ages eight to ten!

An unskilled reviewer is likely to match each virtue he mentions with a fault. He will call attention to little errors, such as those in type-setting. He may miss the real point of the article. If conceited, he is likely to argue with the author. He is almost sure to make his review long and dull.

Editors and readers like short, interesting reviews. Publishers like favorable reviews from which they can quote. Many editors will not publish a review that condemns a book, because that one reviewer has probably misjudged the purpose of the book and the reader-group for which it is intended. These editors say: "We will select for review those books that may be recommended very favorably. Those of less value to our readers we will not review, because our magazine's space is limited." This is undoubtedly a wise policy.

A truly "bad" science book comes along only now and then. It may be ignored unless the editor feels that it should be brought to the attention of readers through an adverse review. Such a book is *Worlds In Collision* by Velikovsky, reviewed unfavorably in *The Science Teacher,* October, 1950, page 137.

Abstracts are the facts of books and articles "evaporated to dryness." They contain only the

"mineral matter" of even the juciest writing. They are written chiefly to place their authors' reports (usually of research) in the permanent files of learned literary reference. There scholars may find the titles and authors' names, decades—even centuries — from now. Abstracts contain just enough information to permit a specialist to decide whether the full reports may be of value in further research.

Abstracts, of course, are wholly objective. They are little used in popular periodicals, but usually appear in publications (as *Chemical Abstracts*) devoted entirely to them.

Annotations are the small and sparkling members of the Review Family. In their tiny spaces (one word to 20) they may flash and gleam like gems. Their messages may be sharp like on awl, keen like a knife, pungent as a whiff of ammonia.

The annotation is both objective and subjective. It tells—without repeating its title—what the story is. It expresses—with every word counting—how the annotator is affected by the qualities of interest, information, advice, activity, or even inspiration the article possesses.

Things small and fine always challenge their craftsmen. The writer of annotations must probe his mind for bright, strong, meaty words—or find them in that unique dictionary, a thesaurus. He must concentrate on short, clear phrases. His comments must fill but a few lines of print.[1]

The best annotations of books and articles are favorable and quotable. If an annotator feels that an item would not serve a certain reader-group, he should try to decide whether it might not interest another. As in the review, if his judgment is altogether unfavorable, he may wisely drop the title from his list. His final choices will be "a selection of the best."

Science teachers should introduce The Review Family to their classes. Each of the four forms of reporting offers a variation from themes and notebooks. Each will improve habits of reading for comprehension. Each will develop skills in the selection of words to fit ideas. Each will stimulate an interest in published reviews and enhance the service of periodicals to youthful readers.

Today's men and women of science—the professionals—use annotations, abstracts, reviews, and digests freely. Should not the scientists of the coming generation, now before us daily, start the practice in *our* classrooms?

---

[1] In two decades (1924–1944) of publishing the annual *High School Science Library*, the writer annotated about 5000 books. Ninety-nine per cent of these notes were one line or less in length.

Books in Review

In his review of two recent, significant books Henry Commager, distinguished professor of history at Columbia University, argues that the California teachers' oath and restrictions on scientific knowledge test not behavior but opinion. This line of argument, we believe, should have the serious attention of all science teachers; further, we believe that college students and many of our high school students might well consider in science and social studies classes the problems of the ends and the means in our quest for security and loyalty. With permission of the New York Herald Tribune *we are therefore pleased to reprint this thought-provoking review which appeared in the Book Section October 15, 1950.*

THE YEAR OF THE OATH. George R. Stewart. 156 pp. $2. Doubleday and Company. New York. 1950.

SECURITY, LOYALTY AND SCIENCE. Walter Gellhorn. 300 pp. $3. Cornell University Press. New York. 1950.

THESE are important books; they are also frightening books. They are important because they address themselves to a subject that intimately concerns the security and prosperity of the commonwealth. They are frightening because they reveal that in our search for security we have taken the wrong road—a road that leads not to ultimate security but to ultimate disaster.

In the present crisis—that of protecting the nation against disloyalty and subversion—we are in grave danger of adopting means which will work irreparable harm to the nation and the causes for which it stands. The means which we have adopted—loyalty oaths and investigations, complex security regulations which look to censorship of opinion rather than examination of conduct and secrecy—are not strengthening us, but weakening us. They are not making us better prepared, but destroying our capacity for preparedness. They are not in fact discovering and destroying disloyalty; instead they weaken our unity, sow dissension, deprive the government of talent and intelligence and criticism, and block progress in important fields of science and scholarship.

These are the grand subjects with which these two books, each in its way, deal. One has to do with the effort to enforce conformity in one of the greatest of our institutions of learning, the University of California. The other deals with the broad problem of the relation of the loyalty program to scientific research. Both concern themselves with the effect of the exaction of oaths, the imposition of tests of opinion and association. Both discover that however valid the ends, the means employed are designed to nullify them.

And why is it that oaths, investigations, tests of opinion and association, secrecy, military control, and all the other techniques which we have lately devised, fail to achieve their ends? First, because they do not and cannot discover disloyalty, real or potential. Those who are already disloyal—and their number is happily infinitesimal—do not hesitate to take oaths and are ordinarily circumspect in their conduct and their associations. This is not mere theory but fact.

Second, oaths and investigations tend increasingly to test opinion rather than behavior and the result here is not only confusion but error. There are clear tests for disloyal conduct; there are no clear tests for disloyal opinions or associations, for no two people agree on what constitutes disloyal opinions or associations: to judge by recent Congressional committee hearings some Senators think General Marshall and Secretary Acheson both guilty of disloyalty in these forms! The result of the application of these tests is simply to deprive the government of the services of many of its most talented citizens. It is to create political tests for government service—a thing that has always been odious in our history.

Third, these tests work irreparable hardship on countless individuals guilty of nothing but unorthodox opinions. But the harm does not stop there. Far more important is the discouragement of unorthodox opinion generally, the discouragement of criticism, of originality, of independence of thought and conduct—of all those qualities the nation needs most if it is to retain its leadership in science and social science—and in the military.

What we have in these two books are case studies of the actual operation of these tests, of the drive for conformity and the insistence on secrecy. Let us look first at the simplest situation—that of the University of California, and by implication of all other institutions that have found themselves, or will find themselves, under attack. The story is by now painfully familiar. Under the leadership of a former attorney for W. R. Hearst, the Board of Regents of the University of California embarked upon a program of eliminating communism and subversion from that institution. There was no evidence that there was any communism or subversion, and none ever turned up, but no matter—there might be, and besides it was a good gesture! The method was to require all teachers to take an oath that they were not communists or members of any subversive organization or had any commitments in conflict with impartial scholarship and the free pursuit of truth. Those who could not

sign this statement were to be dropped from the university.

Now what was wrong with this? After all, the layman asks, who can object to an oath of this nature? Surely any one who objects is automatically under suspicion? This was the reasoning of at least ten of the Regents, and of a good part of the press and of members of patriotic organizations in California.

Yet a moment's reflection will reveal that everything is wrong with this method and this argument. First, it is probably unconstitutional, for the Constitution of the State prescribes an oath of loyalty and provides that no other oath shall ever be exacted. This constitutional injunction the Regents flouted. Second, it singles out university teachers as a special class, implying that when they took the original oath they were guilty of perjury. Third, it is based on the wholly fallacious assumption that the University was a hotbed of communism, and this in the face of overwhelming evidence to the contrary. Fourth, it created a most dangerous precedent for the future. If Regents could add, at will, to "minimum requirements" for teaching, where were they to stop? What was to prevent them exacting, next year, an oath of disapproval of socialized medicine or of Secretary Acheson's foreign policy? "It is well to remember" writes Mr. Gellhorn, "that invasions of freedom usually have inconspicuous beginnings. The danger lies in the precedent which those inconspicuous beginnings sometimes serve to establish."

And what was the result of all this furor? The Regents did not discover any communists. They did not uncover any subversive teaching. They did not therefore achieve even their minimum ends. What did they do? For a year they distracted a great community of scholars from their proper business of teaching and research. They cast suspicion on the integrity of that community of scholars. They seriously endangered the principle of academic freedom—a principle basic to the advance of learning and of science. They announced to the student body that the faculty was not to be trusted, and left the impression that it spoke not as free men but as men under compulsion. They gave support to the odious doctrine of guilt by association, a doctrine peculiarly dangerous in a community of scholars.

Perhaps the most ominous part of the story is that which concerns the action of the Regents on April 21, 1950. At that meeting Regent Giannini, exasperated by the uncooperative attitude of the faculty, burst out "I want to organize 20th Century vigilantes who will unearth communists and communism in all their sordid aspects and I will, if necessary." Here, clearly, was advocacy of change by lawless and unconstitutional means. The other Regents—"sympathetically affiliated" with Mr. Giannini—did not protest.

We come, then, to the second of our books, and one with an even more ominous moral. For the issue here is not merely one of academic freedom—though it, too, is involved in Mr. Gellhorn's study—but of national survival. The story that Mr. Gellhorn unfolds is complex, but the central issue can be stated simply enough. "The question," Mr. Gellhorn says, "is simply whether restriction upon the flow of knowledge within the United States may not so gravely impair this country's efficiency that the cost of secrecy will become prohibitive."

Here again the end—to protect scientific and military secrets from enemies—is laudable. And here again the means is not designed to achieve the end, but achieves instead very different ends. We are in grave danger, so Mr. Gellhorn tells us, of erecting a Maginot line of secrecy in the realm of science. "The American people may some day discover that they have been crouching behind a protective wall of blue prints and formulas whose impregnability is an utter delusion." For the elementary fact is that there are very few scientific secrets, and that almost all efforts to achieve secrecy in science defeat themselves. What American atomic physicists, or biologists, learn, Russia can learn. Our superiority lies in our resources of skilled scientists and in our prodigious industrial and engineering skills which can translate the findings of science into tools and weapons. Anything that interferes with the free flow of scientific knowledge, anything that compartmentalizes science or scientists, anything that deprives us of the services of our most original scientific minds, will seriously affect our position—and our safety.

Today our scientific preeminence is endangered. It is endangered by precisely those policies our government has adopted to assure it. There is no longer that free interchange of ideas so essential to scientific progress. We are not even able to train nuclear physicists, for as the director of the Defense Department's weapons' evaluation group has observed "at present no adequate course in nuclear engineering can be taught at a university." Some of our best scientists have been driven from government service; many more refuse to work on "restricted" research projects for they know that they cannot do their best work in an atmosphere of secrecy and surveillance.

What is the difficulty? It is a two-fold one. First, the authorities have failed to distinguish carefully between scientific research of immediate military value, and other scientific research. They have therefore consigned a vast body of science to the category of secrecy. There must be a thorough "declassification" of scientific findings and projects if our science is to forge ahead. Second, the loyalty program has failed to distinguish between behavior and opinions. The result here has been to deprive the nation of much of the talent that it needs and, worse still, to create an atmosphere not conducive to original thought and investigations.

Mr. Gellhorn has elaborated these themes with numerous examples, and with acute comment. There is, for example, the alarming case of the "American Review of Soviet Medicine." It was a wholly scien-

tific journal, concerned exclusively with reporting on the latest developments in Russian medicine. It had, up to 1946, substantial circulation and much value. Subscribers were simply afraid to take it any more, and subscriptions vanished—and so, too, the magazine. This didn't hurt Russian medicine; it hurt American medicine. Or there is the case of the distinguished scientist who was barred from an important job because it was rumored that he had supported Wallace—hardly in itself a badge of disloyalty—and the rumor, as it turned out, was false. Or there is the case of Dr. X, who had contributed some forty monographs on biochemistry, and who was ordered to resign or be fired. It turned out that various charges had been made against him; his parents were foreign born; he had belonged to two organizations that were suspect—neither of them listed on any government "subversive" list, and he had attended a lecture by someone thought to be a "fellow traveler." Dr. X was cleared and resigned. His experience, unfortunately, is not an isolated example of action taken on the basis of rumor alone.

"The nation's identification of conformity as a prime ingredient of reliability," Mr. Gellhorn concludes, "must ultimately discourage the acquisition and discussion of new ideas. . . . Every society that has stilled protest by compulsion or fear has suffered immobilization and ultimate decay." And he quotes that observation of Justice Jackson which applies with equal force to the issue of academic freedom: "The Nuremberg evidence is that the seeds of eventual annihilation for Hitler's power were sown when he began burning books, exiling scholars, persecuting scientists, and closing down on information."

No one who ponders the evidence of these two books can avoid the conclusion that the fatal and inescapable fault of the present drive for "loyalty" is that it places dangerous obstacles in the way of the search for truth and does irreparable harm to the Republic.

Classroom Ideas and Demonstrations

General Science

Demonstrations of Mist, Fog, Cloud, and Rain

By FREDERICK W. JEFFS, Bamber Bridge Training College, Lancashire, England. Exchange Teacher, 1950-51, Enterprise Junior High School, Compton, California

Mist. Take a large and substantial round-bottomed flask, or a two-liter reagent bottle. Fit it with a one-hole stopper and tube so that air may be compressed in it. Shake up a little water in the flask to insure the presence of plenty of water vapor. Press in the stopper very firmly, connect to a foot or hand pump, and begin compressing. It is advisable to secure the flask so that it is not likely to roll. (Ed. note: We prefer a one-liter, side-neck Erlenmeyer flask and solid stopper.)

After a short time the stopper is driven out with a bang, and a gray mist or cloud appears in the flask. At once replace the stopper and recommence pumping. The mist disappears. Continue pumping until the stopper is driven out once more; the mist reappears.

It is important for the class to realize that the compression-and-decompression is merely a convenient routine to raise or lower the temperature of the air in the flask. The teacher cannot emphasize this too strongly, especially in the lower grades.

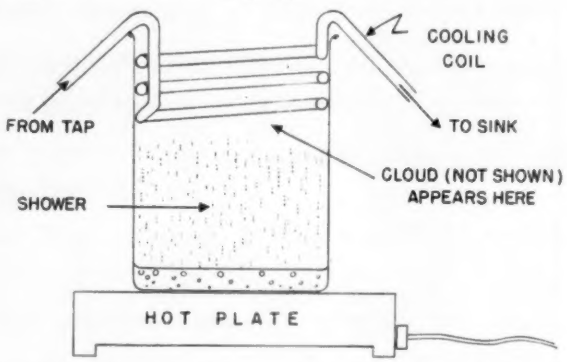
The principles illustrated are: (1) when a mass of air is cooled below the dew-point temperature, a cloud or mist may be formed; and (2) if a mass of air in which water particles are suspended in the form of a mist is heated, the mist is likely to disappear.

Fog. Introduce smoke to the flask by lowering in a piece of smouldering rag on a wire. Alternatively, blow in a little cigarette smoke through a tube.

Insert the stopper firmly and repeat the experiment. If tobacco smoke from the mouth is used, it is interesting to notice how this very largely disappears as the compression continues. The class can usefully be guided to note and explain this. Finally, the stopper is blown out as before, but a very much thicker mist or fog is the result.

Principle involved: The abundant provision of nuclei for condensation and the frequency of occurrence of a larger particle in the precipitation results in the more impenetrable fog.

Cloud and Rain. Make a coil of two or three turns of narrow gauge copper or lead tubing (say, one-eighth-inch internal diameter) of such size that it will just fit into a large beaker and rest at the top. Connect one end of this coil to the tap and allow the other end to communicate with the sink. Pour a half-inch depth of trichlorethylene into the beaker, and set the latter up over on a hot plate or over a burner. Turn on the water so that the cooling coil can fulfill its purpose.



The following phenomena will be noticed. When the liquid begins to boil, or even before, a cloud formation with a very level base occurs above it and steadily rises. (This stage is transitory and should be sought carefully. It may be disturbed by draughty conditions, etc.) Soon there is a very manifest cloud around the cooling coil. It will now be noticed that a miniature shower of rain is falling from this cloud into the liquid. This continues. Disregard in observation of the "rain" any large drops of "dew" which fall from the coil itself. If it fits close to the sides of the beaker, the nuisance is minimized as the "dew" tends by surface tension to run down the latter.

There is little loss of liquid. The vapor is very heavy, and not much passes the cooling coils. Trichlorethylene is not inflammable, but it is anaesthetic and poisonous. One would not encourage the student to inhale from the beaker. Performed

as indicated, there is no danger in the ordinary laboratory. The teacher in setting up this experiment for private trial should avoid smoking. Trichlorethylene passing through burning tobacco breaks down into a number of products, one being *phosgene* or carbonyl chloride which is deadly.

For various reasons trichlorethylene is a wonderfully effective liquid to use in this demonstration, but, if it is not available, kerosene will give a useful result. Kerosene, however, is inflammable, so it is necessary to make suitable modifications in method. For instance, remove the flame when the liquid is nearly boiling, or heat it over a large water bath.

Physics

Short Objective Tests in Physics

By IRVING W. LUMPKIN, Chairman, Science Department, Austin Senior High School, Houston, Texas

This article is an abstract of a comparative study of the gain in factual information in physics made by the students taking teachers' conventional tests and students taking frequent short objective tests.

The problem was to determine the relative merits, in terms of factual information gained by the students, of a testing program in high school physics which incorporated frequent short objective tests which were furnished in mimeographed form to the teacher, as compared to the program of testing which was currently employed in the Houston schools.

The classes for study consisted of representative groups of the regular Physics II students enrolled in the spring semester in the Houston public schools. Four schools were represented, comprising a school population of 6322 students with a total of 302 physics students. Of the 302 students included in this experiment, there were 133 students in the experimental groups and 169 in the control groups.

The classes were taken at random and placed in two groups so that all determining factors were held relatively stable except for the test factor which was consistently different throughout the experiment.

In order to determine the extent to which the two groups were equated, tabulations were made of the time of day the classes met, the students' chonological ages, intelligence quotients, credits earned, and the scores made on the *Cooperative Physics Test* given at the beginning of the experiment. During the experiment, 15 short objective tests were given the experimental groups. The control groups took the teachers' conventional tests. At the close of the experiment a second *Cooperative Physics Test* was given to determine the gain made by each group. Tabulations of these scores and of the gains were made.

Conclusion. Houston high school Physics II students made a significant gain in factual physics information when given short frequent objective tests.

Recommendation. As a result of the findings in this study, it is recommended that short frequent objective tests be given Physics II students. It is to be remembered, however, that the only educational objective here considered is gain in factual information.

Chemistry

Using Principles of Electrolysis In Teaching and Testing

By ROBERT H. CARLETON, Executive Secretary, National Science Teachers Association

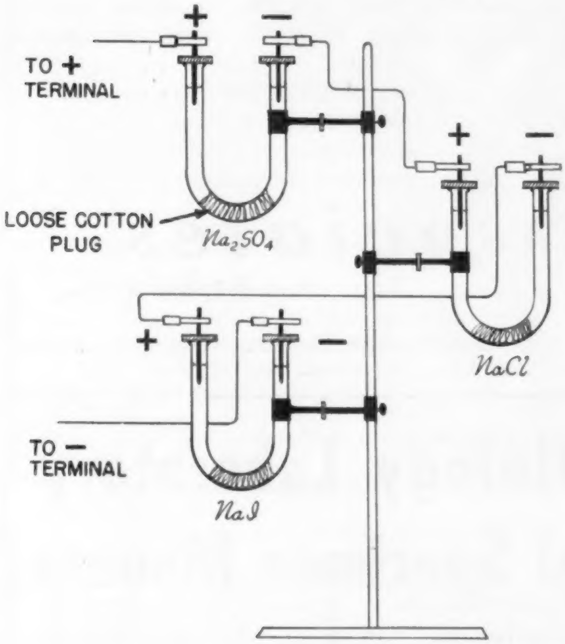
The preface of most chemistry textbooks and the statements of objectives to be found in most courses of study and syllabi agree that one of the chief goals of instruction in chemistry is "to develop the ability to apply principles." How can we teach for this objective and how can we test for student improvement in this ability?

Using principles of electrolysis as the setting, one method might be to "teach" the electrolysis of hydrochloric acid and cupric chloride solution and the process of electroplating with copper from copper sulfate solution. The "testing" might be done by later asking students to predict and explain the results of electrolyzing a water solution of zinc chloride. But why not teach and test at the same time?

My chemistry students always enjoyed this demonstration, and most of them liked the write-up I asked them to do to explain it. Arrange three large U-tubes with a large, *loose* plug of cotton or glass wood at the bend, and support them by burette clamps on a ringstand as shown in the drawing. Prepare six two-hole rubber stoppers to fit the U-tubes, each stopper containing a 4-to-5-inch long carbon rod one-eighth inch in diameter.

Into U-tube number 1 (top) pour rather concentrated sodium sulfate solution until the arms

are half filled. Then add concentrated litmus solution until the arms are filled to within half an inch of the top, blue litmus to the left (later to be made positive), and red to the right (later to be made negative). Fill U-tube number 2 (middle) half full of sodium chloride solution; then add red litmus solution to the left-hand arm and colorless phenolphthalein solution to the right. Fill U-tube number 3 (bottom) half full of potassium (or sodium) iodide solution; then add starch solution to the left-hand arm and colorless phenolphthalein solution to the right.



Insert the rubber stoppers and carbon electrodes and connect the upper left-hand U-tube arm to the positive terminal of a 20-to-30-volt D. C. source of power. Connect the right-hand arm to the left-hand arm of the second U-tube, and the right-hand arm of this to the left-hand arm of the third U-tube. When the right-hand arm of the latter is connected to the negative terminal of the power supply, the circuit will be complete. All three left-hand arms will contain positive electrodes, and the right-hand arms will contain negative electrodes. Allow current to flow and the electrode reactions to continue until there have been definite and pronounced color changes in the arms of all the U-tubes. Occasional lifting of a stopper and stirring with the electrode will promote distribution and uniformity of all the colors.

The write-up consisted of making one set each of "before" and "after" drawings in color of the three U-tubes. The color changes were to be accounted for by explanations, either in words or equations, of what happened at each electrode. The students had, of course, been habituated to ask three questions about any electrolysis reaction: (1) What kinds of ions (including those of water) are attracted to each electrode? (2) Which ions are discharged after they get there? It is here that the color changes should be helpful. (3) What is the result of the oxidation (at the anode) and of the reduction (at the cathode) of these ions? In the next day's discussion of the reactions, correct explanations were developed for the benefit of all the students, and the commercial applications of the reactions in U-tubes 2 and 3 were discussed. (P.S. Five to ten or 15 years later, I wonder whether they could still get the answers right.)

Sixth Nationwide Testing Program For High Schools Announced

More than a "current events quiz" or a test of superficial acquaintance with newspaper headlines, the 1951 high school testing program will again be based on the *Cooperative Test of Recent Social and Scientific Developments.* The program should be of interest to all science teachers since, from the start, it has been a fusion of social studies and science, the latter with its social implications. Increased emphasis on citizenship education in high schools throughout the nation makes this year's program especially timely.

The deadline for registration in the program is March 1. Schools are urged to enroll early to ensure prompt receipt of program materials and inclusion in the final program report. Further information and registration forms may be obtained from the sponsor of the program, the Cooperative Test Service Division, Educational Testing Service, 20 Nassau Street, Princeton, New Jersey, or 4641 Hollywood Boulevard, Los Angeles, California. Cost of participation is 12 cents per pupil and a two-dollar school registration fee.

The 40-minute test is a 75-item, multiple-choice test. It is prepared in cooperation with Dr. E. F. Lindquist of the State University of Iowa. One section of the test deals specifically with knowledge and understanding of developments in science, technology, and medicine.

The Basic Program of Unesco

By Blanche G. Bobbitt

Supervisor, Science, Mathematics, and Health Coordination
Division of Secondary Education, Los Angeles City Schools

THE POLICIES and goals of UNESCO are stated in the basic program which was adopted by the first session of the General Conference of UNESCO (Paris, 1946). The program deals with the activities in education, science, and culture that are considered appropriate matters for international cooperative action. The basic program serves two purposes: to guide member states in their pursuit of UNESCO's objectives and to direct the work of UNESCO's Secretariat.

Briefly, the main understandings of the basic program are:

1. To eliminate illiteracy and encourage fundamental education.
2. To obtain for each person an education conforming to his aptitudes and to the needs of society, including technological training and higher education.
3. To promote through education respect for Human Rights throughout all nations.
4. To overcome the obstacles to the free flow of persons, ideas, and knowledge between the countries of the world.
5. To promote the progress and utilization of science for mankind.
6. To study the causes of tensions that may lead to war and to fight them through education.
7. To demonstrate world cultural interdependence.
8. To advance through the press, radio, and motion pictures the cause of truth, freedom, and peace.
9. To bring about better understanding among the peoples of the world and to convince them of the necessity of cooperating loyally with one another in the framework of the United Nations.
10. To render clearing-house and exchange services in all its fields of action, together with services in reconstruction and relief assistance.

UNESCO's basic program consists of a number of resolutions grouped under the following seven different heads: (1) Education; (2) Natural Sciences; (3) Social Sciences; (4) Cultural Activities; (5) Exchange of Persons; (6) Mass Communications; and (7) Relief Services.

Let us consider the resolutions which define the basic program of the Natural Sciences activities of UNESCO:

1. Development of International Scientific Cooperation.

UNESCO shall encourage international cooperation in the field of the natural sciences, assist the development of the means of achieving such cooperation, and facilitate its extension to all regions of the world.

To this end, it will:

Promote by means of financial aid or of services the development of international scientific organizations, unions, associations, and institutions making a significant contribution to international scientific cooperation;

Arrange for the publication of lists of research institutes and their expert staffs, of scientific equipment, periodicals, and of indexing, abstracting, and documentation services;

Promote the classifying, indexing, and abstracting of scientific and technical publications;

Promote the standardization of scientific and technical terminology in the main languages of the world;

Develop field science cooperation offices to facilitate the spread of knowledge, the coordination of research, and the application of their results.

2. Assistance to Research, Especially for the Improvement of the Living Conditions of Mankind.

UNESCO shall assist research to improve the living conditions of mankind.

To this end, it will:

Encourage and assist research centers and coordinating bodies engaged in work of this type of international or regional interest;

Participate actively in the establishment of United Nations laboratories.

3. Teaching and Popularization of Science.

UNESCO shall cultivate and facilitate the spread of scientific knowledge and the cultivation of a scientific outlook, as well as a better understanding of the role of science and technology in modern society.

To this end, it will:

Study the content of science syllabi at the various levels of school and university teaching, and recommend any appropriate action;

Stimulate and facilitate, with special attention to the general public, activities likely to promote a better understanding of science and technology and of their role in society.

There have been five sessions of the General Conference of UNESCO. These have been held as follows: first session, Paris, 1946; second session, Mexico City, 1947; third session, Beirut, 1948; fourth session, Paris, 1949; and fifth session, Florence, Italy, 1950. At each of the meetings of the General Conference an annual program is adopted to activate UNESCO's basic program by planning projects in the fields of education, science, and cul-

ture. The yardstick for all projects includes the following questions:

1. Will the projects promote the welfare of the people?
2. Will they enlist the cooperation of intellectual leaders?
3. Will they produce tangible results in the next few years?

Although UNESCO has operated within an annual budget of only six to eight million dollars, tremendous progress has been made with the various projects undertaken. One explanation of the effective utilization of UNESCO's budget has to do with the organization's aim, which is to initiate and stimulate but not to operate indefinitely. In keeping with this aim, UNESCO carries on many activities in cooperation with other specialized agencies of the United Nations, particularly the World Health Organization and the Food and Agriculture Organization, and with many international governmental and non-governmental organizations. For example, the grants-in-aid provided by the Natural Sciences Department of UNESCO are made through existing international scientific organizations, many of which have been functioning for a long period of time.

Nominating Committee at Work—

One of the most important NSTA committees is that on Nominations. This year's committee, under the chairmanship of Dr. S. Ralph Powers, has already started its work. All NSTA members and the consultants of all affiliated groups are invited to send suggestions for nominees to the chairman or to any member of the committee.

Offices for which nominees are to be named include: *president-elect, treasurer, secretary,* four *regional vice-presidents,* four *members* of the *Board of Directors.*

In addition to Dr. Powers, Teachers College, Columbia University, New York City, the 1951 committee includes: Mr. Lawrence Bromberick, Mount Lebanon Senior High School, Pittsburgh 16; Mrs. Marjorie Campbell, elementary science supervisor, Washington, D. C., public schools; Mr. Arthur Houston, Keene High School, Keene, New Hampshire; Miss Sarah Kaplan, Box 2423, Salt Lake City, Utah; Mr. Hugh Townsend, Muncie High School, Muncie, Indiana; and Mr. Stanley E. Williamson, Oregon State College, Corvallis.

Please send in YOUR suggestions *now.*

Topics for Term Reports in Earth Science

(Continued from page 25)

ASTRONOMY

The Milky Way
Our Sun
Lunar and Solar Eclipses
Meteors and Meteorites
Rockets
Conquest of Space
Interplanetary Travel
Famous Observatories of the World
Famous Astronomers
Story of the 200-inch Telescope
Instruments for Solar Research
Story of Our Calendar
Time Zones of the World
Origin of the Planets

GEOLOGY

The Mississippi Delta
Story of the Appalachian Mountains
Story of the Rocky Mountains
Grand Canyon of the Colorado River
Volcanic Cones in the United States
Rocky Mountain National Park
Yellowstone National Park
Soil Erosion
T. V. A.
Grand Coulee Dam
Story of the Panama Canal
Mineral Wealth of the Seas
History and Geology of the Great Lakes
Local Topography
Deserts of the World
Birth of a Volcano, Paricutin
The San Francisco Earthquake
Control of Soil Erosion
The Earth's Interior
Origin and Age of the Earth

MINERALOGY

Precious and Semi-precious Stones
The Story of Oil
From Iron Ore to Steel
Our Oil and Coal Resources
Strategic Minerals in World War II
Radioactive Minerals

METEOROLOGY

The U. S. Weather Bureau
Climates of the World
The Story of the Barometer and Thermometers
Air Mass Analysis
Clouds and Their Meanings
Aviation and Weather

MISCELLANEOUS

The Smithsonian Institute
A Visit to a Planetarium
The Oceanographic Institute
Prehistoric Man
Food for the World

PRECIPITATES

Announcements, News, and Views of Current Interest

Teachers of general science, biology, health, and chemistry will be interested in *Arthritis—And the Miracle Drugs,* pamphlet no. 166 of the Public Affairs Committee, 22 East 38th Street, New York City 16. 20 cents.

Instructions and materials for building a Geiger counter are available at reasonable cost from Science Kits Ltd., 5514 Hollywood Boulevard, Hollywood 28, California.

Claimed as the first extensive effort to film the beauty of underground caverns of the United States is the recent release by the World in Color Productions, 108 Church Street, Elmira, New York, of 12 three-and-one-half-minute, full color motion pictures. Titles include Carlsbad, Mammoth Cave, and others.

Volume 1, No. 1, of the *Welch Physics Digest* rolled from the press last October, and subsequent issues will be published quarterly. Published by the W. M. Welch Scientific Company, 1515 Sedgwick Street, Chicago 10, the aim of the Digest is to select and simplify material from the many physics articles published throughout the world. More than a dozen "how-to-do-it" articles in the first issue, for example, stamp the Digest as a must for every alert physics teacher. It will be sent free on request to interested teachers asking for it.

Ward's Natural Science Bulletin for November carries, among its many interesting items, an account of "The Chubb Crater Expedition." Informative and useful to all science teachers, the Bulletin is now in its 24th volume. Write to Ward's Natural Science Establishment, Inc., 3000 Ridge Road East, Rochester 9, New York, to get on the mailing list.

Two teaching aids recently announced through the pages of *The Science Teacher* are proving unusually helpful. Referred to are the D. C. Heath *Chem-Formulator* (secondary and even college levels) and the Judy Company's *Mechanettes* (upper-elementary through secondary levels).

Recently announced is a Health Instruction Guide for Secondary School Teachers ($4.50). Prepared and published under the leadership of J. Post Williams, superintendent of Tulare county (California) schools in cooperation with 27 local and state organizations, the book is a continuation of the Health Instruction Guide for Elementary Schools ($1.55). Copies may be obtained by writing to Mr. Williams, Visalia, California.

Gratifying administrative support of better facilities for science instruction came from M. Marcus Kiley, assistant superintendent of Springfield, Massachusetts, schools, writing in *The Massachusetts Teacher,* October, 1950, as follows. "It is time to examine the instrumentation of our science classes. The time is here for the science teachers of our junior high school to search through the senior high school equipment with the privileges of claiming all instruments which they can use to advantage with junior high school classes. What the junior high schools take away, the senior schools can have no cause to lament. There are fields above senior high school to be searched for newer and better kinds of equipment."

A set of eight wall charts showing the construction and operation of familiar electrical devices has been released by the School Service Department of the Westinghouse Electric Corporation, 306 Fourth Avenue, Box 1017, Pittsburgh 30 ($1.00 a set). Printed in two colors on heavy paper and measuring 25 by 38 inches, they give detailed descriptions of the automatic washer, electric iron, fluorescent lamp, etc.

Rated as "superior" by NSTA evaluation committee are the four booklets in the conservation series, *My Land and Your Land,* published by the National Wildlife Federation, Inc. (25 cents each; see "Clip 'n Mail," p. 55). Scientifically accurate, excellently written for children, and beautifully illustrated in full colors; suitable for use in science and social studies. Adapted to use in grade three to junior high school.

(*Please mention* THE SCIENCE TEACHER *when you write*)

Clip 'n Mail

These "coupon service" pages announce the availability of free and low-cost business-sponsored teaching aids for science, all of which have been REVIEWED and APPROVED by the NSTA Evaluation Committee. To procure copies of desired items, fill out the corresponding coupons and mail these, together with any remittance required, to the NSTA Executive Secretary, 1201 Sixteenth Street, N.W., Washington 6. Watch these columns for additional offerings in future issues of *The Science Teacher.* (Print or type coupons.)

MY LAND AND YOUR LAND CONSERVATION SERIES. *National Wildlife Federation, Inc.* Beautifully illustrated booklets; accurate and interestingly written. Suitable for use in science and social studies. Designed to overlap various grade levels, the four booklets cover grades 3 through 8 or 9. Twenty-five cents each.

SCHOOL MATERIALS ON MONOSODIUM GLUTAMATE. *International Minerals & Chemical Corporation.* Information and demonstration sample (while the supply lasts) relating to the intensifying effects of monosodium glutamate on natural food flavors. Of special usefulness in biology, chemistry, general science, and food studies.

BETTER LIGHT FOR OUR CHILDREN. *American Structural Products Company.* Instructive and timely bulletin on important subject. Based on studies made in conjunction with University of Michigan. Specially useful to administrators and to teachers of all grade levels. Well illustrated; in color.

SCIENCE TEACHERS' GUIDE FOR WOOD EXPERIMENTS. *Timber Engineering Company.* Instructions and study questions for 18 experiments with wood. Useful for group activities and for special projects. Suitable for general science, biology, chemistry, and physics. Prepared in consultation with NSTA. Fifty cents a copy.

HISTORY OF COPPER, BRASS, AND BRONZE. *Copper and Brass Research Association.* Informational booklet well suited to use in general science and chemistry. Illustrations, some suitable for opaque projection.

MEDICAL USES OF BLOOD—A MANUAL FOR SECONDARY SCHOOL TEACHERS. *American National Red Cross.* The report of a committee of the American Association for Health, Physical Education, and Recreation. Contains questions and answers on the composition and functions of blood and procurement and uses of blood as a medicine. Includes suggested student activities, suggested integrations, a brief quiz, and a list of resource materials.

TIME TELLING. *Hamilton Watch Company.* A basic unit on the mechanics of a watch and how it works by Dr. Herbert S. Zim. Presents a comprehensive interpretation of Time Telling, its measurement and importance in our daily lives; stresses the role of watchmaking in the development of techniques for mass production. Teacher's manual, wall chart, and student lesson folders available to science teachers of grades 7 to 12 exclusively.

SCIENCE IN STEELMAKING. *United States Steel Corporation.* Eight issues in 1950, each devoted to a new scientific principle in steelmaking. Designed to keep students and teachers informed of new developments as they occur in laboratories and mills. Suitable for use in physics and chemistry, junior high science, and technical or shop courses.

SCHOOL GARDENGRAM. *Friends of the Land.* A how-to-do-it pamphlet useful at elementary and secondary levels—and even to adults. Timely and practical suggestions relating to biological science, elementary science, and conservation.

Please send me ____ copies of **My Land and Your Land** booklets, as indicated below, at 25¢ each. (Remittance enclosed.)

____ copies of **Would You Like to Have Lived When—?** (Grades 3, 4, 5)
____ copies of **Raindrops and Muddy Waters** (Grades 4, 5, 6)
____ copies of **Plants and Animals Live Together** (Grades 5, 6, 7)
____ copies of **Nature's Bank—The Soil** (Grades 6, 7, 8)

Name ____________
School ____________
Address ____________
Post Office ____________ Zone ____ State ____________

Please send me free one set of your school materials on monosodium glutamate.

Name ____________
School ____________
Address ____________
Post Office ____________ Zone ____ State ____________

Please send me free one copy of **Better Light for our Children.**

Name ____________
School ____________
Address ____________
Post Office ____________ Zone ____ State ____________

(Remaining coupons on next page)

Our Advertisers

Please send me ____ copies of the **Science Teachers' Guide for Wood Experiments** at 50¢ each. (Remittance enclosed.)

Name ________________

School ________________

Address ________________

Post Office ____________ Zone ______ State ________

Please send me ____ free copies of **History of Copper, Brass, and Bronze.**

Name ________________

School ________________

Address ________________

Post Office ____________ Zone ______ State ________

Please send me ____ free copies of **Medical Uses of Blood—A Manual for Secondary School Teachers.**

Name ________________

School ________________

Address ________________

Post Office ____________ Zone ______ State ________

Please send me ____ free copies of **Time Telling.**

Name ________________

School ________________

Grade ____________ Number of Students ____________

Address ________________

Post Office ____________ Zone ______ State ________

Please send me, free of charge, future issues of **Science in Steel Making.**

Name ________________

School ________________

Address ________________

Post Office ____________ Zone ______ State ________

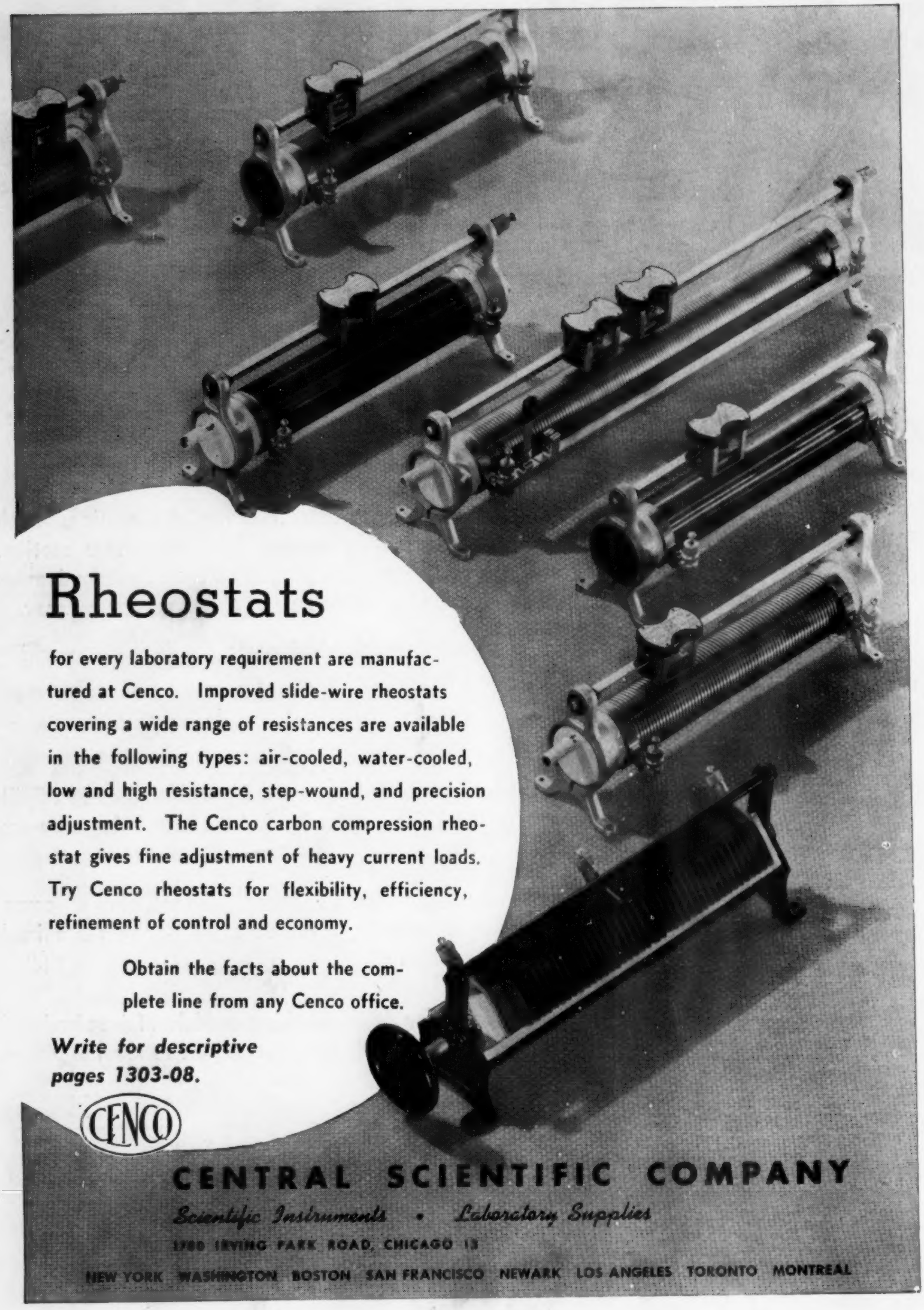
Please add my name to your mailing list to receive copies of School Gardengram regularly.

Name ________________

School ________________

Address ________________

Post Office ____________ Zone ______ State ________


Rheostats
for every laboratory requirement are manufactured at Cenco. Improved slide-wire rheostats covering a wide range of resistances are available in the following types: air-cooled, water-cooled, low and high resistance, step-wound, and precision adjustment. The Cenco carbon compression rheostat gives fine adjustment of heavy current loads. Try Cenco rheostats for flexibility, efficiency, refinement of control and economy.
Obtain the facts about the complete line from any Cenco office.
Write for descriptive pages 1303-08.
CENCO
CENTRAL SCIENTIFIC COMPANY
Scientific Instruments • Laboratory Supplies
1700 IRVING PARK ROAD, CHICAGO 13
NEW YORK WASHINGTON BOSTON SAN FRANCISCO NEWARK LOS ANGELES TORONTO MONTREAL